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Pinophyta (Gymnosperms) of New York State

Edward A. Cope
The L. H. Bailey Hortorium
Cornell University

Contributions to a Flora of New York State IX
Richard S. Mitchell, Editor

1992

Bulletin No. 483

New York State Museum

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Albany, New York 12230

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PREFACE

OUR GOAL in producing this series is to present a useful and authoritative account of the plants of New York State. These contributions are intended to reflect the knowledge and taxonomic opinions of specialists who prepare the manuscripts while following a generalized format for consistency. Inclusion of ecological, distributional, medical, and economic information on each species is also one of our major aims. Habitat references, flowering times, pertinent synonymy, etc., often apply specifically to New York plants rather than to the entire species. Complete illustration should facilitate identification of specimens for those who are not formally trained in botany. Descriptions are original, ordered, and as complete as possible to provide sequential cross-referencing.

Distribution maps accompany species of seed plants, ferns, mosses, lichens. These are plotted by counties, to eliminate pinpointing endangered species and habitats, while offering an accurate visual picture of known collections. Maps are based on the master file at the New York State Museum, Albany, and supplemented by available data (specimens examined by the authors) from herbaria housing significant New York collections. Data or literature citations for any map may be obtained, on approval, from the New York State Museum. We hope that these bulletins will serve individuals with interest in the flora, as well as to provide information for State and Federal agencies, conservation organizations, industry and the scientific community. With these works go our hopes for the preservation and wise use of a precious and lifegiving resource—our State's plant life.

The New York State Flora Committee

The steering council of the New York State Flora Committee met for the first time on January 19, 1976, and established as its goals the promotion of study of the State's plant resources and the publication of this series of museum bulletins. These contributions will be continually updated after publication for possible incorporation into larger volumes at a later date.

Members of the council at the time of this publication are:

- Richard S. Mitchell, Chairman, State Botanist, N. Y. State Museum, Albany (Vascular Plants)
- Charles J. Sheviak, Curator of Botany, N. Y. State Museum, Albany (Vascular Plants)
- Norton G. Miller, Chief Scientist, N. Y. State Biological Survey, Albany (Bryophytes)
- Clark T. Rogerson, The N. Y. Botanical Garden, Bronx (Fungi)
- George J. Schumacher, Biology Dept. SUNY, Binghamton (Algae)
- Gordon C. Tucker, N. Y. State Biological Survey (Vascular Plants)

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IMPORTANT NOTE

All economic uses, folklore, medical and pharmaceutical notes, uses as foodstuffs, etc., are compiled from the literature and do not represent an endorsement by the authors or the New York State Museum. Some of the uses may, indeed, be dangerous if incorrectly employed. Some are not effective and are presented for historical interest only.

LEGEND

FOR ALL ILLUSTRATIONS, THE FOLLOWING LETTER-DESIGNATIONS APPLY:

A. Male cone(s) (microstrobilus)	J. Silhouette
B. Male cone scale(s) (microsporophyll)	K. Vegetative bud
C. Branchlet bearing male cones	L. Branchlet with juvenile leaves
D. Branch or spray	M. Branchlet(s) enlarged with adult leaves
E. Female cone(s) (megastrobilus)	N. Branchlet enlarged with juvenile leaves
F. Female cone scale(s)	O. Spur (short shoot) and sheath
G. Female cone bract	P. Adult leaves
H. Seed	Q. Linear foliage leaves in cross-section
I. Branchlet enlarged with leaves removed	

Pinophyta (Gymnosperms)

The division Pinophyta comprises the classes Pinopsida, Ginkgopsida and Cycadopsida, representing three ancient lineages of trees and shrubs. There are 12 families, over 70 genera and about 650 species of Pinophyta (excluding the Gnetales, a class often included in the group). Members of Pinophyta are distinguished from Magnoliophyta (flowering plants or angiosperms), by their naked ovules that may be borne singly or more commonly on structurally complex scales (megasporophylls) of woody or fleshy, compound cones (megastrobili). Secondary characters that also distinguish the group (with occasional exceptions) are absence of vessels in secondary wood, the presence of resin canals, lack of a gynoecium and perianth, and development of pollen-bearing microsporangia on microsporophylls of morphologically distinct strobili.

Conifers (Pinopsida) represent the largest gymnosperm class, with seven families, 65 genera and about 550 species. They are the only group of gymnosperms native to northeastern North America. Three families: Pinaceae, Cupressaceae and Taxaceae, have species native to New York State. A fourth family, Taxodiaceae (baldcypress family), now usually included in the Cupressaceae, is represented by baldcypress, *Taxodium distichum* (L.) Rich., a rare escape from cultivation. The Cephalotaxaceae (plum-yew family) of southeastern Asia is represented in New York State by only two, rarely-cultivated species of *Cephalotaxus*. The Araucariaceae and Podocarpaceae are tropical families grown only under glass in New York State. *Ginkgo biloba* L., ginkgo or maidenhair tree, is a popular cultivated tree worldwide, and the sole surviving member of the ancient group Ginkgopsida. In New York State, planted trees thrive and their seeds may germinate, but often survive only a few years. The third class of gymnosperms (Cycadopsida) is primarily tropical. Several species are widely cultivated, and *Zamia* species are native in Florida, but cycads can be grown only under glass in the northeastern United States.

Conifers are distinguished from other gymnosperms by a combination of characters, including eciliate or non-motile sperm, simple leaves, and microsporophylls in simple strobili. The compound megastrobilus, (often called the "female cone"), consists of few to many scales, called seed-scale complexes (a term that perhaps best labels a controversial and complex structure). A seed-scale complex consists of seeds, an ovuliferous scale and a subtending, minute to prominent bract that is free from, or so completely adnate to, the ovuliferous scale that it is macroscopically impossible to recognize as a separate structure. The ovuliferous scale is a morphologically complex structure consisting of a branch and megasporophylls fused into a single unit, hereafter, in accordance with past usage in most floristic treatments, called the female cone scale. The term, megastrobilus, will here be considered equivalent to the female cone (except in Taxaceae, where the megastrobilus cannot be called a cone). The microstrobilus and microsporophyll will be referred to here as male cone and male cone scale, respectively.

During the Mesozoic Era, spanning over 200 million years, the gymnosperms and their relatives occupied most of the habitable surfaces of the earth. Today's gymnosperms represent only a remnant of the diversity of that era. Although there are only about 650 species (less than one quarter of 1% of the plant species in the world), the gymnosperms still occupy a disproportionately large land surface and have great ecological and economic significance.

KEY TO FAMILIES

1. Female reproductive structure a solitary, globose ovule or seed partially enclosed by a red, fleshy aril, with megasporophylls or cone scales not discernible; leaves flattened, cuspidate or acuminate.....1. **Taxaceae**
1. Female reproductive structure a conical, oblong or globose, woody or fleshy cone; ovules (1-) several to many; cone scales obvious (except *Juniperus*), peltate or flattened and oblong; leaves scale-like or linear and flattened, usually acute(2)
 2. Female cone conical or oblong-cylindrical, the scales oblong or flabellate, 25 or more; leaves arranged so that the branchlet is visible, linear or linear-lanceolate, much longer than wide; leaf completely visible.....2. **Pinaceae**
 2. Female cone globose, conical or oblong-cylindrical, the scales peltate or oblong, 12 or less; leaves appressed, the bases completely clothing the branchlet, subulate or mostly scale-like, nearly as wide as long, closely imbricate so that the leaf is only partially visible3. **Cupressaceae**

Taxaceae (Yew Family)

The Taxaceae: a family of five genera and 23 species with a significant degree of reproductive specialization, the most noteworthy example of which is a unique, fleshy, berry-like aril that partially surrounds the seed. This structure is currently considered to be a reduced compound strobilus (Chamberlain, 1935; Hart, 1987; Keng, 1969; Wang et al., 1979; Wilde, 1975). Although members of the family are distributed primarily in the Northern Hemisphere, the monotypic genus, *Austrotaxus*, is native in New Caledonia, and *Taxus wallichiana* Zucc. [*T. sumatrana* (Miq.) Delaubr.] occurs in Indonesia. Taxad species are

often of wide-ranging, but with remarkably disjunct distributions. *Pseudotaxus* (a monotypic genus), *Amentotaxus* and most members of *Torreya* occur in China, while *Taxus*, the largest genus, is represented in North and Central America, Europe and Asia. Florida and northwestern North America each have a single native species of *Taxus* and *Torreya*, but, in northeastern North America, the family is represented only by *Taxus canadensis* Marshall. *Torreya taxifolia* Arn., the stinking cedar or Torrey pine of Florida, is nearly extirpated in the wild, but grown occasionally ornamentals in southeastern states. It was once utilized for fence posts. The Chinese Torreyas are harvested for their lumber, and *Torreya californica* Torrey, California nutmeg, is grown ornamentals. *Taxus* species are among the most widely planted shrubs for ornamental purposes, with numerous cultivars having been developed (Cope and Vance, 1991). The seeds and foliage are poisonous to man and some mammals.

FAMILY DESCRIPTION

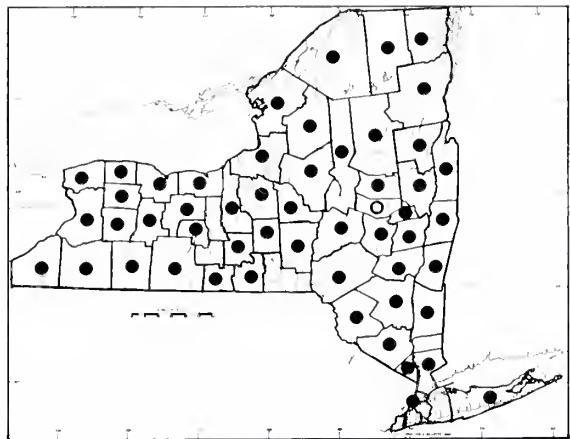
Evergreen shrubs or small (to large) trees, the Taxaceae have sinewy, red, dark purple or brown branches covered with green (later brown), decurrent leaf bases. The leaves are usually alternate and 2-ranked, bifacially flattened, linear to linear-lanceolate, short-petiolate, attenuate, cuspidate (or acuminate), papillose, with revolute margins and no resin canals. The adaxial surface of the leaves is lustrous, dark green with the midrib raised or not, and the abaxial surface is yellow-green with a longitudinal band of stomata on each side of the midrib. The species of Taxaceae are mostly dioecious, but our native species, *Taxus canadensis* Marshall, can be monoecious as well. Male cones are axillary, solitary (in ours) or in 2-4 terminal or subterminal racemes, sessile or minutely peduncled, globose or often becoming oblong or conical, the sterile scales 8-many, the fertile male cone scales 3-numerous and peltate; microsporangia (2) 3-9, and pollen grains lack bladders or wings. The megastrobilus (the term "cone" cannot be applied to the female reproductive structure in Taxaceae) consists of a solitary ovule that is terminal on a short axillary shoot or peduncle with 6-20 subtending, persistent, spirally arranged or opposite and decussate sterile scales. The seed is dry and hard, surrounded partially or completely by a green, purple, white or red aril. The aril is a fleshy part of the megasporophyll that develops from the axis (ovuliferous scale) or apex of the ovule-bearing axillary shoot. The embryo has two cotyledons. The diploid chromosome number is 24 or 22 (*Taxus*).

1. TAXUS

Common Name: yew

Authority: Linnaeus, Species Pl., II, p. 1040, 1753

Taxus is a genus of 10 species (and 2 artificially derived hybrids) of shrubs and small trees, distributed primarily in the Northern Hemisphere. *Taxus brevifolia* Nutt., grows in western North America, and it is potentially important in cancer research. The endangered species, *T. floridana* Nutt. ex Chapm., Florida yew, is the only native in the southeastern United States, while the more common *T. canadensis* Marsh. is the native yew of northeastern North America. The genus is taxonomically difficult because of variability and the overlapping nature of the limited morphological features used to distinguish species. Yew is of immense horticultural importance, since these shrubs are planted in great numbers worldwide for a wide range of ornamental purposes, but mostly planted next to buildings or as hedges. At least 300 cultivated varieties have been developed and named. The older of these varieties are cultivars of *T. baccata* L., which is much-cultivated in Europe. The limbs of *T. baccata* have proved to be excellent material for bows, and the wood makes fine furniture. New York's only native species, *T. canadensis*, is exceptional in that its irregular, elongate and spreading growth habit does not adapt itself well for ornamental use, and it is also the only species where monoecious plants are reported in an otherwise dioecious genus. *Taxus baccata* L. of Europe and *T. cuspidata* Sieb. & Zucc. of Japan have been reported as rare escapes from cultivation in New York. The artificial hybrid, *T. cuspidata* × *canadensis* (*T. × media* Rehd.) has now become the most popular yew, with the greatest number of cultivars in the current North American nursery trade (Cope & Vance, 1991).



1. *Taxus canadensis* Marshall

Common Names: Canadian or American yew, ground-hemlock, dwarf yew, shinwood, creeping hemlock

Type Description: Marshall, Arbust. Amer., p. 151, 1785

Synonyms: *T. baccata* ssp. *canadensis* Pilger, *T. baccata* var. *minor* Michx., *T. baccata* var. *procumbens* Loudon, *T. minor* Britt.

Origin: Native to northeastern North America

Habitats: Rich woods, thickets, swamps, bogs and ravines, especially on north-facing slopes, in a variety of soils, generally moist, cool, partially to fully shaded situations

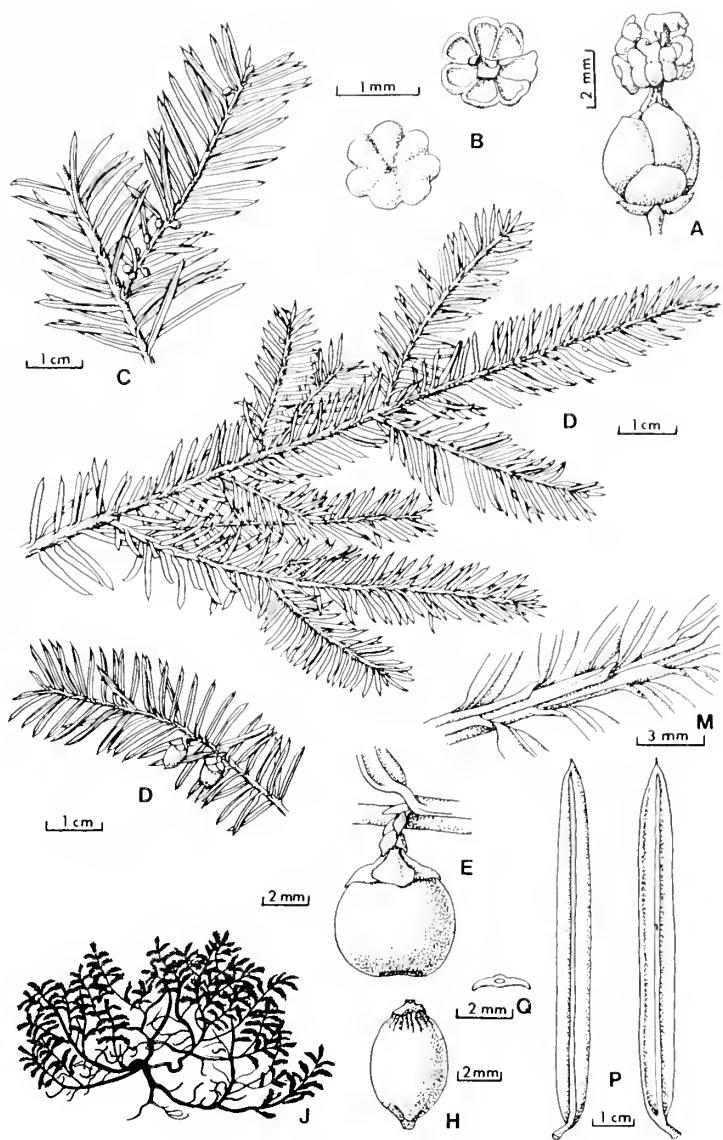
Habit: Shrub with many spreading, ascending (or pendulous) branches, often a sprawling, rather open bush. the branches, prostrate, rooting, forming open to dense thickets

Pollination: April-May

Mature Aril and Seed: July-September of the 2nd season

General Distribution: Newfoundland to southeastern Manitoba and northeastern Minnesota and Iowa, south to northeastern Virginia, West Virginia, Northeastern Kentucky, eastern Ohio, Michigan and northeastern Iowa; disjunct in northeastern Kentucky, west-central Indiana and southeastern Iowa

Description: Plants **monoecious** or **dioecious**; **megastrobili** solitary, occasionally paired, axillary on the second (or third) year branchlets, nearly sessile; **peduncle** about 1 mm long, covered with scales or scale-like leaves; **female sterile scales** 15-18, appressed, imbricate, membranous, the lower (basal 9) ovate, concave, about 1 mm long, acute, pale brown to transparent, the remaining 6-9 broadly ovate to flabellate, 1.5-2.5 mm long, 3-4 mm wide, transparent or light green, often rugose; **aril** nearly enclosing the ovule, globose or subglobose, 6-8 mm long, about 6 mm wide, hard and green when young, fleshy and bright red when mature, dispersed or drying and deciduous the first year; **seed** ovoid, about 5 mm long, 4 mm wide, apiculate, mostly 2-angled near the apex, brown, lacking wings; **cotyledons** 2; **male cones** solitary, scattered in axils of leaves on first-year branchlets, erect, globose before expansion, then short oblong-cylindrical, about 4 mm long, 2 mm wide, green to yellow-green; **peduncles** sometimes concealed but usually surpassing the bud scales, 2-4 mm long, scaly at the base, naked towards the apex; **male sterile scales (bud scales)** 8, decurrent on the basal 1/3-1/2 (1.5-2.0 mm) of the peduncle, loosely and partially covering the upper 1 mm of peduncle, scarious, glabrous, entire, the basal 2 keeled, gibbous, somewhat hardened or indurate, 1.5-2.0 mm long, the remaining 6 broadly ovate 1.5-3.0 mm long, 2-3 mm wide; **male cone scales** 6-8, peltate; **stalk** less than 0.2 mm long;



lamina orbicular, about 0.5 mm in diameter; **microsporangia** 4-9, longitudinally dehiscent, about 0.2 mm long; **pollen** lacking wings or bladders; **leaves** crowded, 2-ranked, pectinate, forming a deep V along the upper side of the branchlet, linear, abruptly narrowed at the petiole, blades 1.0-1.5 (-2) cm long, 1.5-2.3 (-3) mm wide, cuspidate, glabrous, entire, the margins incurved, **adaxial surface** dark green, the midrib inconspicuously to prominently raised, lacking stomata, **abaxial surface** concave, dull, yellow-green, with a longitudinal band of stomata on each side of the dark green, raised midrib, stomatal bands about 0.2 mm wide or twice the width of the midrib and green margins, usually consisting of 6 rows of stomata; **petioles** 0.5-1.0 mm long, broadened into a decurrent base; **buds** ovoid, conical or obovoid, 2-3 mm long, the lateral buds smaller, green to red-brown; **bud scales** imbricate, appressed, keeled, acute or obtuse, hardening and turning brown, persisting for several years; **branchlets** covered by the decurrent bases of the leaves and therefore green the first year, green or red-brown the second and third years, red-brown to gray-brown thereafter, the decurrent leaf bases eventually shedding; **branches** spreading or ascending, the lower ones often pendulous at the tip, prostrate and rooting; **bark** scaly, red-brown to brown; **shrub** to 2 m tall, mature plants with many ascending, spreading and pendulous branches; **roots** dark, fibrous, often adventitious ($2n = 24$).

Importance: The genus *Taxus* is of immense importance in ornamental horticulture, but *T. canadensis* is little-used for ornament because of its sparse, sprawling growth habit. Only a few cultivated varieties of this species have been developed. The pulp of the red aril is sweet and edible, and can be used for jams. The seeds and other parts of the plant, however, are strongly toxic to humans. Extreme caution should be exercised, since ingestion of leaves, stems, seeds or roots of yew can result in poisoning by taxane derivatives, yielding a rash, weakness, coma, gastroenteritis, diarrhea, dizziness, heart arrhythmia and possible death due to respiratory failure.

Infraspecific Variation: Although *T. canadensis* is often reported to be monoecious in floras, manuals and other literature, field observation and examination of hundreds of herbarium specimens have yielded this author no affirmation of the monoecious condition. There is remarkably little morphological variation within the species outside of growth habits of individuals. Distinctions between this and other members of the genus *Taxus* are sufficiently vague that all yews have sometimes been considered to be subspecies of a monotypic genus. Widely separated geographic ranges and the convenience of listing historically recognized taxa seem largely responsible for the maintenance of separate species within the group.

Pinaceae (Pine Family)

The Pinaceae: a worldwide, primarily north temperate family of 10 genera and about 200 species. The genera are well defined, often displaying highly specialized characteristics. The largest genus, *Pinus* (ca. 100 spp.), is a diverse group of species occurring in a wide variety of habitats, almost entirely in the Northern Hemisphere. The other larger genera, *Abies* (39 spp.), *Picea* (34 spp.), *Tsuga* (10 spp.) and *Larix* (11 spp.) are mostly found at high elevations or in boreal forests. *Pseudotsuga* (5 spp.) grows in western North America and eastern Asia, while *Cedrus* (4 spp.) is found in the Himalayas, northern Africa and the Mediterranean Region, and the remaining three genera (*Cathaya*, *Keteleeria*, *Pseudolarix*) are endemic to China. The five largest genera are represented in the native flora of northeastern North America, including New York State. *Pseudotsuga menziesii* (Mirb.) Franco (Douglas-fir), the great lumber tree of western North America, also widely cultivated for ornament and Christmas trees, has been recorded as a rare escape from cultivation in the Northeast. *Cedrus* species are popular as cultivated plants in warm parts of the United States, but have a limited cultivated distribution in New York. *Pseudolarix* is mostly found only in botanical gardens in North America. Members of the pine family dominate a number of forest types of the North Temperate Region, including vast expanses of taiga and montane forest, and they are prominent in many second-growth, often fire-related, ecosystems as well. Utilization of Pinaceae for lumber and pulp continues to be an industry of great economic importance. Members of the family are also planted extensively for Christmas trees, and cultivars for ornamental use have been developed from most genera (Cope, 1986). Turpentine and other products of the resin are extracted from the trees, and edible seeds of some pines are harvested and marketed.

FAMILY DESCRIPTION

Trees of the Pinaceae are long-lived, monoecious, evergreen (deciduous in *Larix* and *Pseudolarix*), often very tall (reaching heights of 90 meters or more), with spire-like or conical, spreading to dense or open, crowns that may be irregular to quite symmetrical. The trunks reach diameters of two meters and are often devoid of branches for 1/3-2/3 their height under shaded forest condition with dead branches occasionally persisting. The yellowish-brown, red-brown or gray to black bark is smooth or roughened by thin, flaking scales or deeply furrowed with thick, sometimes corky scales. Branches are slender to stout, rigid or brittle, ascending to horizontal or pendulous, and, in some species, capable of rooting when in prolonged contact with the sub-

strate. Branchlets may be terete and smooth or more commonly ridged and grooved, or roughened from the decurrent, often raised and persistent leaf bases, glabrous or pubescent, the trichomes rusty, brown or gray, sometimes glandular. A greatly reduced or dwarfed branchlet called a spur or spur shoot is present in some genera, persisting two to several years, growing at the rate of only about 0.5 mm per year (ceasing growth after one year in *Pinus*), and bearing annual rings formed by scars of the scarious, often persistent, bud scales. Buds are small and globose or ovoid to large and oblong-cylindrical, red-brown with many appressed scales, the tips of the outer scales sometimes spreading. Leaves are bifacially flattened (bilaterally flattened in *Cedrus* and some species of *Picea*), and are of one or two kinds on the same plant. Juvenile leaves, when present, are usually scarious (linear and green in *Larix* and *Pseudolarix*), deciduous or persistent for several years in a reflexed, brittle, flaking condition, the bases hardened, decurrent and often raised on the branchlet. Adult leaves are sessile or raised on woody, projected decurrent bases, spirally arranged on the branchlet or in clusters of 2 to many on spur shoots. They are linear, angled or flattened, emarginate or obtuse to acute, often pungent, sometimes glaucous, pale green, gray-green, blue-green to dark green, glabrous, entire or minutely serrulate, aromatic, amphistomatic or hypostomatic, with 1-12 resin canals and one or two vascular bundles. Male cones are solitary, small (2-13 mm long), globose or more commonly oblong-cylindrical and loosely or tightly clustered at the base or extending halfway up the first-year branchlets (and sometimes older ones). The short, naked or scaly peduncles of the male cones are loosely and partially (or completely) concealed by the subtending or basal, persistent, scarious sterile scales. These scales are the male cone bud scales, and are attached in a compact spiral cluster where the peduncle joins the branchlet. The 10-180 male cone scales are roughly L-shaped, with 2, small (1-2 mm long) microsporangia that are surpassed at the apex by an apical flap, connective or lamina (rarely merely a knob or beak) that projects at right angles and upward, so that its abaxial surface is exposed, parallel to and facing away from the cone axis. The microsporangia dehisce transversely, obliquely or mostly longitudinally. Pollen grains are numerous, with or without 2 bladder-like wings. Male cones typically wither, turn brown and fall in the first year, but sometimes persist into the second year. The female cones are solitary and initially erect, remaining so or becoming horizontal or pendulous. The short peduncles are usually soon concealed by the reflexed basal scales. From the time of initiation, female cones require 12-28 months for the process of pollination and fertilization to be completed and for mature seeds to be dispersed, though some closed-cone pines retain their seeds in unopened cones for years, the empty cones often persisting whole on the branchlet for many years, or only the axis persisting, and the scales individually deciduous. Female cone scales are sessile, flabellate or suborbicular to oblong, thin or thick, often apically thickened, green or red-purple becoming brown at maturity, glabrous and entire or erose. Each scale is subtended by a concealed or exserted, minute or long-flabellate, spatulate or oblong, erose or lacinate, often subulate-tipped bract. In *Pinus*, the bract soon fuses with the scale, and bracts often reach their full size long before the cone is mature and are exserted at this early stage. Two ovules are borne at the base of each adaxial surface of the scale and are inverted with the acute or two-pronged apex and micropyle facing the cone axis. The seeds are obovate, rhombic, angled or flattened, with or without resin vesicles, usually with an oblique, wedge-shaped, membranous, pale brown, often striated wing. Cotyledons are 3-16 in our species. The diploid chromosome number is 24 almost without exception ($2n = 44$ and $2n = 26$ have been reported for *Pseudolarix* and *Pseudotsuga*, respectively by Khoshoo, 1961).

KEY TO GENERA

1. Adult leaves in clusters of 2-40(2)
1. Adult leaves solitary(3)
 2. Adult leaves in clusters of 2-5 (-7), the bases enveloped in a sheath; mature female cones greater than 3 cm long, the scales 50 or more1. *Pinus*
 2. Adult leaves in clusters of 25-40 at the end of short spur branchlets; mature female cones less than 2 cm long, the scales 10-202. *Larix*
3. Female cone bracts long-exert, 3-pronged; buds acuminate, at least twice as long as wide3. *Pseudotsuga*
3. Female cone bracts concealed or short-exsert, rounded at apex; buds globose, as wide as long or nearly so(4)
 4. Female cones erect, scales falling separately, leaving the naked cone axis still attached; leaves flattened, leaving circular indented leaf scars on the branchlet, bark not coming away with the leaf when detached4. *Abies*
 4. Female cones pendulous when mature, scales falling as a unit; leaves angled or flattened, leaving raised, woody pegs on the branchlet, bark or wood coming away with the leaf when detached(5)
5. Leaves flattened, of several sizes and orientations on the branchlet, obtuse or emarginate, minutely denticulate towards the apex, hypostomatic; the leading shoots flexible and pendulous5. *Tsuga*
5. Leaves angled, of approximately the same size and orientation on the branchlet, pungent (prickle-tipped) or acute, entire, amphistomatic; the leading shoots erect6. *Picea*

1. PINUS

Common Name: pine

Authority: Linnaeus, Species Pl. II, p. 1000, 1753

Pinus is the largest conifer genus, comprising about 100 species, almost entirely distributed in the Northern Hemisphere. Although pines are often considered to be primarily successional elements in mixed deciduous forest zones, they are also major forest components of montane and some lower elevation forests in western North America, and from coastal southeastern states south to Mexico. About 35 species occur in the United States and Canada, 38 in Mexico, 15 in Europe, 23 in Asia and three in North Africa. Six species are native in New York State, where second-growth white pine (*P. strobus*) occupies only a small portion of the area once covered by previous large expanses of white pine forests that developed after clear-cutting in the late 18th and 19th centuries. The genus is easily divided into two large subgenera. The hard or diploxylon pines (subgenus *Pinus*) have two vascular bundles per leaf, mostly with persistent sheaths and leaves mostly borne in clusters of two or three, while the more primitive, soft or haploxylon pines (subgenus *Strobus*, represented only by *P. strobus* in New York State), are characterized by leaves in clusters of five or more (five in *P. strobus*) with one vascular bundle per leaf and deciduous sheaths. In addition to the widely planted and escaping *P. sylvestris* L., scotch pine, *P. thunbergiana* Franco, Japanese black pine, and *P. nigra* J. Arnold, Austrian pine, of Europe have been reported as rare escapes from cultivation in New York. Pines are important worldwide for use in reforestation, as Christmas trees, timber, and as ornamental conifers. The wood is used for building materials, pulpwood for the paper industry, and it is extracted for resins, from which turpentine and other products are manufactured. Edible seeds of some pines are gathered and marketed as "pine nuts."

Description: monoecious; reproductive cycle: female cones are initiated in early fall, but not visible until the following spring, when they open for the first time by a slight separation of their cone scales; pollination then occurs, but fertilization requires an additional year, during which the female cone remains closed and grows larger; male cones develop each year at the base of new-growth of terminal shoots; the female cone matures and opens for the second time in the fall, a full two years after initial development. Seeds may then be shed, or, in some species, they may remain within closed (serotinous) female cones for years; **female cones** solitary or in whorls of 2-4; **at pollination:** erect or horizontal, globose or subglobose or short conical, pink, green, yellow-green or usually dark purple; **after pollination** (prior to the second opening): horizontal or pendulous, narrowly conical, green, yellow-green or light brown; **at maturity:** horizontal or pendulous, conical, ovoid-conical or subglobose, red-brown to dark brown, usually turning gray when weathering over many years, persisting 1-30+ years after maturity (in some species overgrown by the outer trunk or branch bark); **peduncles** 2-20 mm long, visible at pollination, usually later becoming concealed by the basal scales; **bracts** flabellate or obovate, minute, scarcely 1 mm long, erose or minutely denticulate, soon becoming fused to and macroscopically indistinguishable from the scale; **female cone scales** numerous (60-120 in ours), spirally arranged, oblong, concave, thick (5-20 mm long, 4-15 mm wide in ours), light brown to dark red-brown, glabrous, entire; **apophysis** (thickened rhombic or diamond-shaped exposed part of the abaxial surface) usually light yellow-brown, weathering to dark brown or gray, often with a transverse line or ridge across the surface; **umbo** (darker point or boss near the center of the apophysis) unarmed or armed with a straight, spreading, reflexed or incurved **prickle**, the prickle usually with a broadened base, deciduous or persistent; **basal cone scales** nearly half the total number of scales, reduced, mostly remaining closed, more reflexed, their apophyses generally thicker and more rounded or acute, the prickles, if present, persistent and usually longer; **apical cone scales** reduced in width, the uppermost pair usually not separating (together forming a vertical cylinder at the apex of the cone); **ovules** 2-pronged, the prongs slightly exserted to each side of the cone scale base; **seeds** obovate, rhombic, wedge-shaped but with rounded sides, (3-6 mm long in ours) the base acute, the apex rounded or obtuse, usually light or dark brown, mottled with black, glabrous, lacking resin, winged; **wing** obovate, rhombic or wedge-shaped, obliquely attached to the seed at the base, the apex oblique or rounded (6-15 mm long, 4-6 mm wide in ours), but with one side angled, membranous, pale brown, often with dark or red-brown striations; **cotyledons** 4-15; **male cones** tightly and spirally clustered at the base of the first-year branchlet (long shoot), globose or subglobose and stiff at first quickly expanding to become oblong-cylindrical, flexible, often curving or twisting after pollen release, drying, turning brown and deciduous the first year or sometimes persisting into the second year; **sterile scales** 4-10, scarious with transparent margins, red-brown, glabrous, loosely covering the peduncle up to or slightly surpassing the most basal male cone scales, the basal sterile scales 1-2, ovate, about 2 mm long, keeled, indurate, the others ovate, acuminate, longer; **peduncle** erect at first and remaining so or becoming horizontal or pendulous, naked after expansion, usually less than 1 mm long; **male cone scales** numerous (30-180 in ours), spirally arranged, sessile, yellow-brown to red-brown, glabrous; **lamina** projecting at right angles from the stalk and microsporangia, flabellate or orbicular, about 1 mm in diameter, the margins minutely laciniate; **stalk** nearly completely concealed by the microsporangia; **microsporangia** attached to the stalk, dehiscing longitudinally; **pollen** reticulate, 2-winged; **leaves** dimorphic: **juvenile leaves** solitary, either foliar or scarious; **foliar juvenile leaves** appearing only on the first year seedling after the cotyledons, linear (1-4 cm long in ours); **scarious juvenile leaves** subtending adult leaf clusters, linear-lanceolate to ovate-lanceolate, (1.5-12.0 mm in ours), red-

brown to brown or blackened if persistent, becoming dried and brittle and often reflexed or coiled back, deciduous in the first year or persisting for several years before flaking off, leaving raised, decurrent bases or scars on the branchlets; **adult leaves** (1) 2, 3, or 5 (-8) in a cluster at the apex of the spur (reduced branchlet), linear, 2-15 cm long (in ours), 0.5-2.0 mm wide, acute, bright green to gray green, with 2-18 median or marginal resin canals, deciduous with the spur (after 2-5 years in ours), **adaxial surface** flat, slightly or strongly concave (appearing strongly concave in dried specimens), or with a longitudinal, usually serrulate angle or ridge projecting towards the center so that there are 2 surfaces, with a total of 6-20 longitudinal rows of stomata, **abaxial surface** convex or flat, with 6-18 longitudinal rows of stomata; **sheath scales** (bud scales of the spur buds) 8-12, crowded in the axil of the juvenile leaf, subtending adult leaf cluster, scarious, ovate to oblong or obovate, increasing in length and transparency from base of the spur outward, 1-22 mm long, red-brown, glabrous, with transparent, long-fimbriate, partially-fused margins, the threads or filaments interweaving, persistent, soon encircling the spur tip and the base of the adult foliage leaves to form the sheath; **sheath** becoming tighter with the addition of the following year's sheath scales (in diploxyton pines), becoming ragged at the apex with the spreading and tearing of the first-year sheath scales, 2-9 mm long, usually gray or black, deciduous with the spur and the adult or foliage leaves; **buds** ovoid to oblong-cylindrical, large, acute or obtuse, greatly expanding as the long shoot elongates and the first adult leaves appear, usually very resinous, the resin in white or amber accumulations sometimes completely covering the bud, usually red-brown, enveloped in the long transparent threads of the fimbriate margins of the scales; **bud scales** (which become the scarious juvenile leaves) many, tightly appressed, ovate to lanceolate, about 2-9 mm long (in ours), acuminate, scarious, the outer tips usually spreading and sometimes reflexed, red-brown, glabrous, the margins transparent and fimbriate; **branchlets** dimorphic; **long shoots** thin and flexible to stout, yellow-green to red-brown, pale-brown or dark brown to gray, glabrous, rough to the touch due to the persistent juvenile leaves or leaf bases, the bases raised 1-2 mm on the branchlet, decurrent, forming conspicuous to inconspicuous grooves or ridges the first and second year, then spreading and forming wide striations on the branchlet and finally separating into rectangular, truncate scales that gradually flake off, the branchlets ultimately less roughened or nearly smooth; **spurs** (abbreviated branchlets or short shoots) borne in the axils of the juvenile leaves, about 1 mm long, gray, glabrous, ringed by scars of the caducous sheath scales (in *P. strobus* and other haploxyton pines, and a few diploxyton pines) or completely covered by the persistent sheath scales, bearing the adult leaves at the apex, persistent 2-5 or more years, falling with the adult leaves still attached, leaving a circular or transversely elliptic scar about 1 mm long on the long shoot; **bark** smooth or scaly on young trees, fissured or scaly sometimes forming thick corky plates on older trees, yellow-brown, red-brown to gray or dark brown; **branches** usually long horizontal, ascending in young plants, spreading, often slender, usually brittle (short and stout in *P. resinosa*); **crown** conical to narrowly conical, round-topped or open and irregular; **trunk** typically 25-100 cm in diameter, devoid of branches in the lower portion or clothed to the base depending upon habitat, shrubby or usually **trees** 2-30 m tall; **root systems** usually with a deep taproot, with wide-spreading, stout, woody lateral branches that may be shallow or deep with age.

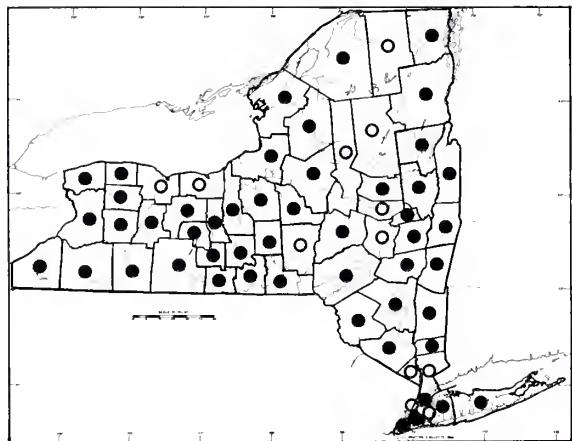
KEY TO SPECIES

1. Leaves (needles) in clusters of 5; sheaths deciduous; female cones pendulous, 8-20 cm long 1. *P. strobus*
1. Leaves in clusters of 2 or 3; sheaths persistent; female cones horizontal or erect (rarely pendulous), 3-8 (-10) cm long (2)
 2. Leaves nearly all in clusters of 2 (4)
 2. Leaves mostly in clusters of 3 (less often 2) (3)
3. Leaves flexible, 2 or 3 per cluster; sheaths usually more than 5 mm long; young branchlets glaucous; peduncle of female cone about 4 mm long (plants rare in NY) 2. *P. echinata*
3. Leaves stiff, 3 per cluster; sheaths about 5 mm long; young branchlets not glaucous; peduncle of female cone 7-10 mm long 3. *P. rigida*
4. Leaves mostly less than 7.5 cm long; mature sheaths mostly less than 5 mm long (6)
4. Leaves mostly greater than 7.5 cm long; sheaths mostly greater than 5 mm long (5)
5. Branches slender, flexible; young branchlets glaucous; leaves 2 or 3 per cluster, merely folding when bent; mature sheaths mostly less than 8 mm long 2. *P. echinata*
5. Branches thick, stout; young branchlets not glaucous; leaves consistently 2 per cluster, snapping or breaking when bent; sheaths mostly greater than 8 mm long 4. *P. resinosa*
6. First-year branchlets (long shoots) not glaucous; female cones mostly less than 4.5 cm long; leaves mostly twisted 1/4 - 1/2 turn (8)
6. First-year branchlets (long shoots) glaucous; female cones mostly greater than 4.5 cm long; leaves straight or twisted 1 and 1/2 turns (7)
7. Leaves twisted (ca. 1.5 turns), occasionally 3 to a cluster; mature sheaths 5-8 mm long; juvenile leaves persistent, 1.0-1.5 mm long; female cone scales armed with persistent or deciduous prickle 2. *P. echinata*

7. Leaves not twisted, straight, 2 per cluster; mature sheaths 3-6 mm long; female cone scales armed with deciduous prickle; juvenile leaves deciduous, 3-4 mm long.....5. *P. virginiana*

8. Female cones often remaining closed, pressed against the branchlet, often contorted or incurved, unarmed; leaves 2-4 cm long, mostly less than 1.5 mm wide; resin canals 2; mature sheaths 1.5-2.5 mm long; juvenile leaves 1.5-3.0 mm long; bark dark brown, not flaking6. *P. banksiana*

8. Female cones closed only when young, not pressed against the branch, not contorted, straight, armed with a deciduous prickle; leaves 4-9 cm long, at least 1.5 mm wide; resin canals more than 2; mature sheaths mostly 5 mm long; juvenile leaves 7-8 mm long; bark red, flaking from upper branches and trunks7. *P. sylvestris*



1. *Pinus strobus* L.

Common Names: white pine, eastern white pine, Weymouth pine, deal pine, American deal pine, northern white pine, American white pine, New England pine, sapling pine

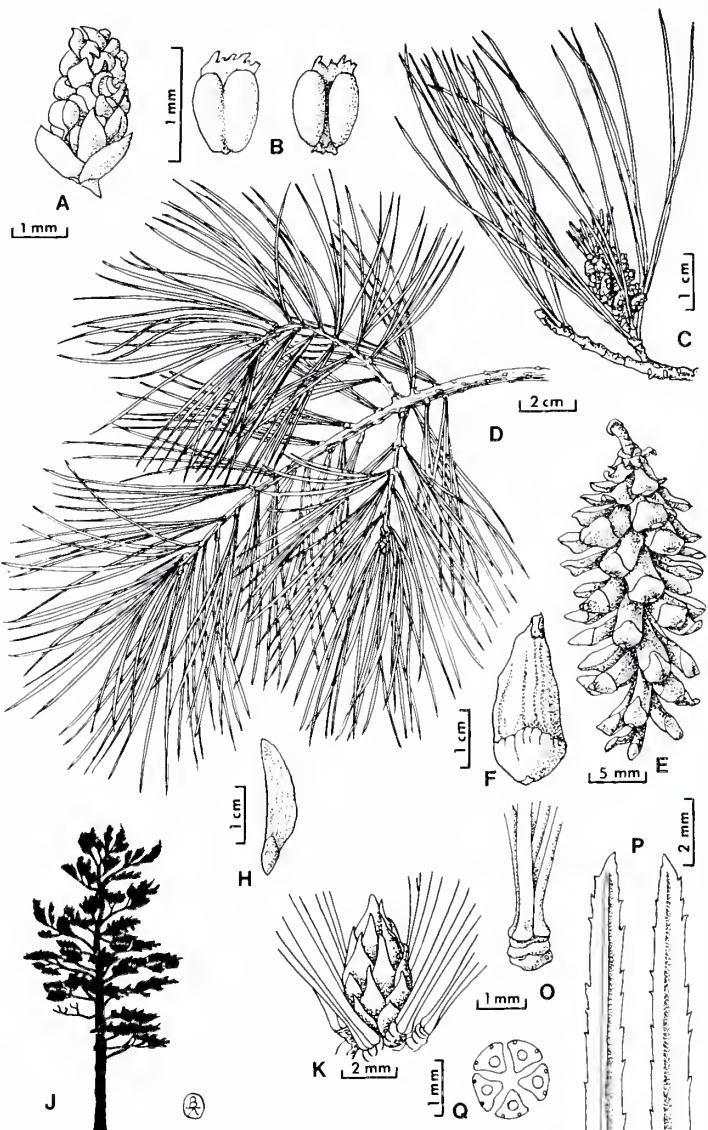
Type Description: Linnaeus, Species Pl. II, p. 1001, 1753

Synonyms: *Strobus weymouthiana* Opiz, *S. strobus* (L.) Small

Origin: Native to eastern North America

Habitats: Occasionally in pure stands, but usually scattered in mixed woods or old field borders, on rocky, well-drained soils and slopes at low elevation, particularly prominent on open west- and south-facing slopes, also in swampy woods, along edges of swamps, bogs and on river banks and north-facing slopes with hemlock, less often growing in wetlands or moist, sandy soils with *P. rigida*. Found on a variety of soils throughout the State, but growing best on well-drained soils, with an ability to compete with brush in openings caused by fire or windthrow and on dry sites and poorer soils. An important overstory tree in well-developed deciduous forests, especially between northern and southern hardwood forest-types. The most mesophytic of our eastern pines, with its relative dominance apparently controlled by the tolerance of associated, competitive species to local edaphic and climatic influences after fire and other disturbances

Habit: Medium to large tree, forming a broad, symmetrical conical crown when young, the long lateral branches sweeping upwards in graceful curves, the crown breaking up when older, becoming irregular, wind-swept and asymmetric, typically with loss of limbs producing large gaps. In crowded forest conditions, branches shorter, forming a narrow crown that over-



tops the mature deciduous forest canopy. Trunks usually straight with little taper and clear of branches under forest condition, or lower branches persisting in open conditions, often forked or tapered upward

Pollination: May-June

Mature Cones Opening: September-November of the 2nd season

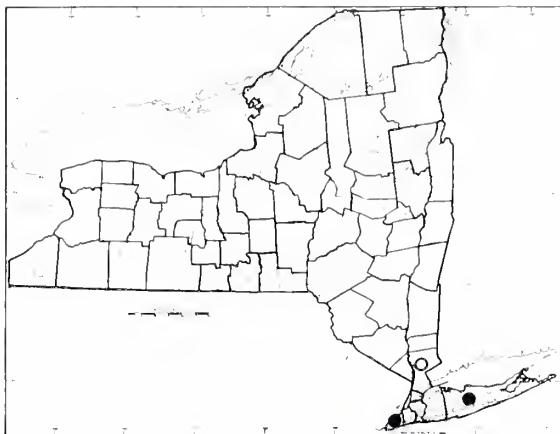
General Distribution: Newfoundland to southeastern Manitoba, south to northwestern South Carolina, northern Georgia, eastern Tennessee, eastern Kentucky, eastern Ohio, northwestern Indiana, northern Illinois and northeastern Iowa; disjunct in Delaware, eastern Virginia, central North Carolina, central Tennessee, western Kentucky, western Indiana and central Iowa

Description: monoecious; **female cones** usually solitary, occasionally paired, axillary, erect when young, pendulous when mature, on peduncles at the base of the previous year's branchlets, oblong-cylindrical, tapered at the apex and base, (8-) 10-15 (-20) cm long, about 2.5 cm wide when closed, 4-6 cm wide when open, purple when young, becoming light brown, weathering gray, usually persisting 3 years; **peduncle** (11-) 15-20 (-30) mm long, about 2 mm in diameter, clothed with awl-shaped scarious, red-brown leaves that are strongly decurrent with spreading tips, grooved, dark red-brown to dark brown when mature, glandular-pubescent, the glandular hairs mixed with other longer scattered or densely matted hairs, some hairs early deciduous; **female cone scales** 60-70, spirally arranged, obovate, concave, about 20 mm long, 15 mm wide, thin, glabrous, entire, red-brown to dark brown, the apical scales 5-10 mm long and narrower, basal scales short-oblong or ovate, 8-10 mm long, about 5 mm wide; **apophysis** flabellate, slightly thickened, pale brown to yellow-brown, later becoming gray; **umbo** unarmed, the raised apex rhombic, often crinkled or folded back, glaucous and purple at first, becoming dark brown; **seeds** elliptic to ovoid, narrowed at both ends, slightly angled, about 6 mm long, 3-4 mm wide, red-brown to dark brown, usually mottled with black spots, **wing** oblong, obliquely angled at the apex, joining the seed body at an angle, 20-22 mm long, about 6 mm wide, pale gray or pale brown, striated black or brown, surpassed by the scale by 3-4 mm; **male cones** 25-40, in compact clusters, covering the basal 1.5-3.0 cm portion of the first-year branchlet, globose and about 4 mm in diameter before pollen release, soon becoming oblong-cylindric, slightly tapered at the apex, 8-9 (-15) mm long, 3 mm wide, purple to dark red-brown or brown, deciduous the first year; **sterile scales** 6-7, ovate, obovate or oblong, 3-5 mm long, with a thick, dark red-brown midrib, the basal scales lanceolate and aristate; **male cone scales** 30-40, spirally arranged, 1.5-1.8 mm long, 1.0-1.4 mm wide, **lamina** not evident before release of pollen, inconspicuous afterward, broadly triangular, about 0.2 mm long, 0.3-0.4 mm wide, acute or laciniate at the apex; **foliar juvenile leaves** 1-2 cm long, with 2-4 longitudinal rows of stomata on each surface; **scarious juvenile leaves** 2-3 mm long; **adult leaves** 5 per cluster, 3-angled, **adaxial surfaces** connivent only for about 2 mm at the base, then divergent, 5-10 (-14) cm long, 0.4-0.7 mm wide, acute, green or light green often with a blue or gray tint, lower margins entire becoming minutely and remotely denticulate toward the middle and upper third of the leaf, the teeth longer and more divergent towards the apex, slightly aromatic, deciduous, together with the spur after the second year, adaxial surfaces 2, each with 2 longitudinal rows of stomata at the base, 2-3 rows in the middle and 3-5 rows near the apex, sometimes with the midrib or angle minutely serrulate, **abaxial surface** flattened or slightly convex, with 2 marginal resin canals faintly visible as thin, pale, longitudinal lines, lacking stomata, slightly aromatic, deciduous after the second year; **sheath scales** usually 8, scarious, acute, concave, folding around the expanding adult leaves, light brown to light red-brown, the lowermost ovate, basally indurate, about 3 mm long, third, fourth and fifth scales ovate, 3-5 mm long, fifth, sixth and seventh scales ovate-lanceolate to oblong, 6-10 mm long, eighth or uppermost scale linear-ob lanceolate, 11-18 mm long; **sheaths** deciduous by the end of the growing season, leaving scars in rings on the spur at the base of the adult leaf cluster; **buds** ovoid-oblong, about 5 mm long, terminal buds usually longer and larger than the lateral, acuminate, brown or red-brown, slightly resinous; **bud scales** numerous, ovate, 3-4 mm long, the basal scales 1 mm or less long, ca. 1.5 mm wide, long-acuminate to aristate, the tips spreading or appressed, red-brown, glabrous, entire; **branchlets (long shoots)** 2-5 mm in diameter, light brown to red-brown and orange-tomentose when young, becoming glabrous and dark brown, gray-brown or gray, smooth, marked by the slightly raised, transversely elliptical scars of fallen spur shoots and the truncate, 1 mm long, 2 mm wide, dried, brown, flaking remnants of juvenile leaves; **spurs** often directed forward along the long shoot, about 1 mm long, gray or dark brown, with 3 circular grooves or rings, revealed by the early-deciduous sheath scales, deciduous together with the adult leaves in the second year; **branches** slender becoming stout, brittle, horizontal, in regular whorls of 5, irregular on older trees; **bark** 3-5 cm thick on older trees, thin and smooth becoming shallowly or deeply fissured with broad, longitudinal scaly ridges, green tinged with red becoming dark gray; **crown** broad, symmetrical, conical when young, breaking up when older, becoming irregular and asymmetrical with large gaps left by branches that are easily destroyed by weather, the branches shorter, forming narrow crown in forest conditions, the long lateral branches sweeping upward in graceful curves; **trunks** to 1 (-2) m in diameter, straight with little taper and usually clear of branches in the forest, often forked and greatly tapered, clothed to the base with branches in open conditions, the tree reaching 30 (-70) m in height; **root system** widely spreading, deep to shallow lateral roots, lacking a taproot, but wind firm with sinker roots ($2n = 24$).

Infraspecific Variation: Variation is limited in white pine of eastern United States, the variable leaf length and density often

reflecting soil or climatic factors. The Mexican variety, *P. strobus* var. *chiapensis* Martinez has finer leaves and a different placement and number of resin canals. The length of the peduncle of the female cone, leaf length and leaf spacing are perhaps the most variable characters that can cause confusion when contrasting characteristics of similar species. *Pinus strobus* is geographically isolated in range from closely related or superficially similar species, such as *P. monticola* Dougl., *P. wallichiana* A.B. Jacks., *P. ayacahuite* Ehrenb., *P. koraiensis* Sieb. & Zucc., and *P. flexilis* E. James.

Importance: White pine was once a dominant forest tree in New York, but a combination of 19th Century cutting and 20th Century hardwood reforestation has rendered it a far less conspicuous element today. The weak, light-weight, straight-grained, easily-worked wood is light in color and only slightly resinous. These characteristics once made it the most important lumber tree in northeastern North America. The estimated 750 billion board feet of white pine lumber once available in northeastern forests was almost completely removed by the beginning of the 20th Century for use in nearly every product from ship masts and matches to furniture, shingles, clapboards, doors, flooring, framing, covered bridges, furniture bracing, trim and crates. Although it was principally used domestically, vast quantities were also exported to the West Indies and Europe. White pine is planted for reforestation purposes because of its rapid growth as well as the quality of its lumber. Through planting efforts and natural regeneration, third- and fourth-growth white pine forests now produce a steady, although much smaller supply of lumber, of relatively small dimensions. White pine is commercially important as a Christmas tree and ornamental, with several important cultivars and many other growth forms having been developed. The inner bark, seeds, young shoots and even the closed young cones have been used as foods by early colonists and Native Americans. All parts of the tree were also used for a plethora of concoctions for healing and nutrition, the most notable of which is the white pine tea made from the leaves, which contain copious amounts of vitamin C. The cones, seeds, bark, and occasionally the leaves, provide food for birds, squirrels, deer and rabbits. The disease, white pine blister rust, is a common disease of white pine caused by an introduced fungal pathogen (*Cronartium ribicola* J.C. Fisch.), which requires gooseberry or currant (*Ribes* spp.) as an alternate host to complete its life cycle. It has had such deleterious effects on white pine populations that planting certain *Ribes* species is outlawed in some states, and it is recommended that no gooseberries be planted near white pine stands or plantations. An insect pest, the white pine weevil [*Pissodes strobi* (Peck)], destroys the terminal leader, retarding reforestation efforts and discouraging wider use of white pine as a Christmas tree.



2. *Pinus echinata* Miller

Common Names: shortleaf pine, old-field pine, shortstraw pine, Arkansas or North Carolina pine

Type Description: Miller, Gard. Dict. ed. 8, no. 12, 1768

Synonym: *P. mitis* Michx.

Origin: Native to the southeastern United States

Habitats: Tree of old fields and sandy savannahs of the Coastal Plain, growing on poor, dry, sandy or rocky soils, in pure stands or intermixed with hardwoods. Native to New York only on Staten Island and extreme southeastern counties

Habit: A medium to large tree with slender, often pendulous branches in regular whorls, forming a broad, conical, rounded or truncate crown, with slightly tapering trunk, often clear of branches for at least half its length at maturity

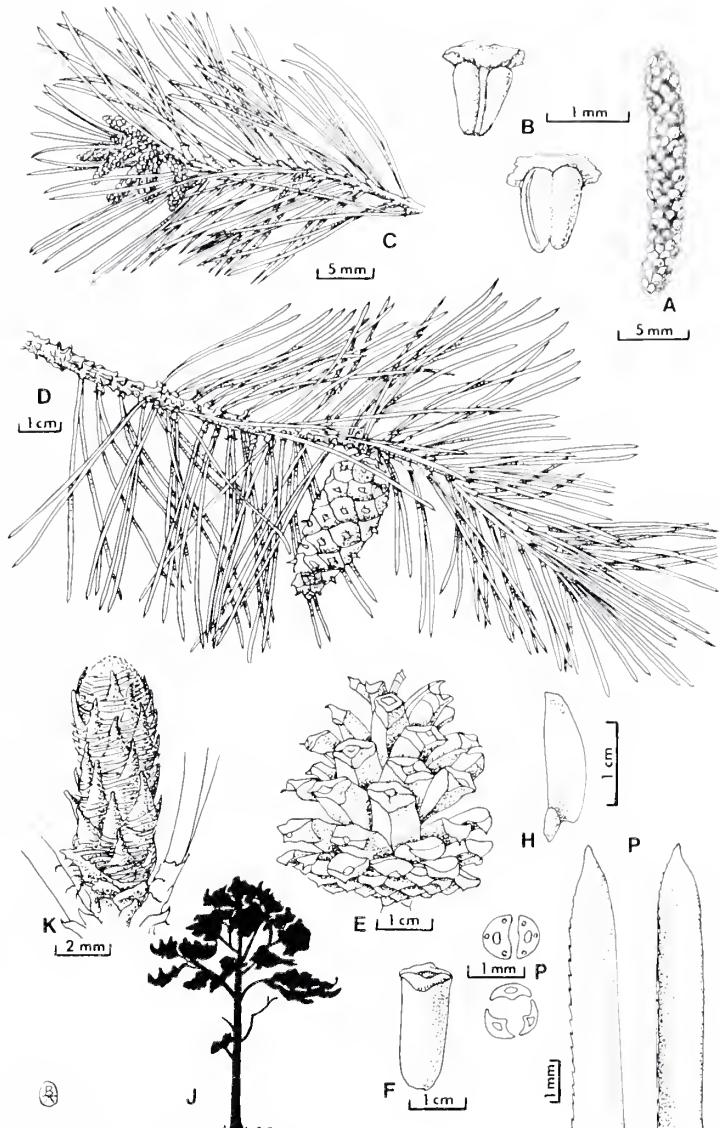
Pollination: April-May

Mature Cones Opening: Variably in the 2nd season

General Distribution: Southeastern New York west to eastern Oklahoma, south to northwestern Florida along the Gulf Coast to eastern Texas

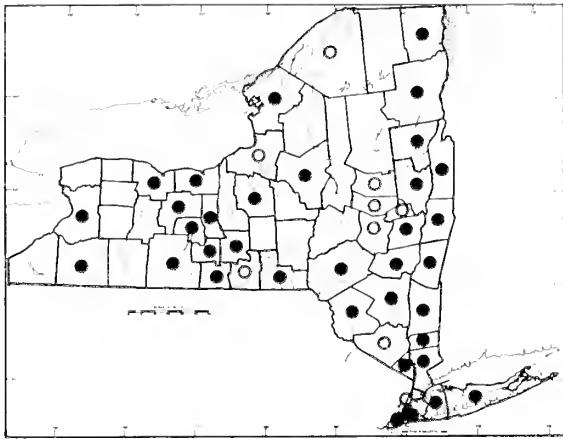
Rarity Status: The Natural Heritage Program lists this species as SH (State historical). It is believed to have been extirpated from the State as a native plant, since no populations have been relocated in the past 15 years

Description: **monoecious;** **female cones** 2-4, rarely solitary, arranged in whorls at the base of the current season's growth, symmetrical, ovoid or conical the first year, narrowly conical the second year, broadly conical or ovoid to subglobose thereafter, 4-6 cm long, 3-5 cm wide at maturity, light red or pink at pollination becoming light red-brown and finally brown when open, weathering gray-brown, persistent for several years; **peduncle** horizontal, scaly, about 4 mm long, 5-6 mm in diameter; **female cone scales** 60-80, spirally arranged, oblong, slightly incurved near the apex, concave, 18-25 mm long, the adaxial surface brown, abaxial surface dark brown, the uppermost 2-4 scales not fully developed, scales gradually reduced toward the cone base, those at the extreme base only 2-3 mm long; **apophysis** rhombic, wider than high, about 5-7 mm high, 9-10 mm wide, light yellow-brown to brown, thickened with a sharp transverse ridge through the middle or rather flattened with a more rounded less prominent ridge; **umbo** bearing a prickle 0.5-1.5 mm long that is usually deciduous (but persistent on the lower scales and a few of the upper scales), the prickle directed outward or downward toward the branchlet, leaving a circular to transversely elliptical gray scar upon falling; **seeds** rhombic, their sides broadly rounded, 4-6 mm long, about 3 mm wide, the apex obliquely obtuse.



base acute or obtuse, brown, usually mottled black, **wing** obovate or oblong, the apex obliquely obtuse or rounded, 1.5-2.0 cm long, light brown with dark brown striations; **male cones** 8-14, covering only about 1 cm of the branchlet base, globose or sub-globose prior to pollen release, becoming oblong-cylindrical, about 5 mm in diameter prior to pollen release, then to 2.5 cm long, 3.0-3.5 mm wide, pale purple or yellow, turning red-brown to brown; **sterile scales** 10, concealing the peduncle and lower male cone scales, red-brown to pale brown with fringed, transparent margins, the basal pair broadly ovate, gibbous, strongly keeled, ridged or winged, indurate, the next 2-3 scales obovate, about 3 mm long, 2 mm wide, the remainder broadly ovate, 4-5 mm long; **male cone scales** 150-180, spirally arranged, crowded, 1.5-1.8 mm long, 0.8 mm wide; **lamina** flabellate, 1.0-1.2 mm long, about 1.2 mm wide, the rounded apex and margins finely serrulate to laciniate and transparent, light red-brown; **microsporangia** about 1.5 mm long, 0.8 mm wide; **scarious juvenile leaves** 1.0-1.5 mm long, apex ovate, often persisting for 3-4 years; **adult leaves** usually 2, sometimes 3 (-4) per cluster, (5-) 7-8 (-13) cm long, 0.8-1.0 mm wide, acute, serrulate, persistent, usually for 2, but as long as 5 years, resin canals 2-3, median, **adaxial surface** concave with strongly incurved margins or, when leaves in clusters of 3, with sharply raised minutely and remotely serrulate angle, stomata in 6-9 longitudinal rows, **abaxial surface** convex with 8-14 rows of stomata; **sheath scales** 12, red-brown with transparent margins, in a series from base outward, ovate to increasingly lanceolate and fringed or fimbriate, the basal pair ovate, gibbous, keeled, semi-indurate, about 1.2 mm long, the next pair broadly ovate, about 2 mm long, the third pair about 3 mm long, the fourth pair fimbriate, 4-6 mm long, the fifth pair spathulate, about 8 mm long, and the final pair lanceolate, nearly 1 cm long, almost entirely transparent; **sheath** becoming tighter with age, blackened and ragged at the apex, 5-8 mm long, falling with the spur leaving a circular to transversely elliptical scar in the axil of the raised, persistent base of the juvenile leaf; **buds** oblong-cylindrical, acute, 4-9 mm long, lateral buds smaller, brown with a gray tinge due to the interwoven, fimbriate upper margins of the scales, marked by red-brown longitudinal lines from the darkened, acuminate apices of the scales; **bud scales** many, closely imbricate and appressed, ovate-lanceolate, 6-9 mm long, acuminate, upper margins long-fimbriate forming a light web around the bud; **branchlets (long shoots)** brittle, about 2-3 mm in diameter the first and second year, becoming 4-5 mm or more in diameter thereafter, roughened in the first three years by the crumpled juvenile leaves and thereafter by the persistent, raised, decurrent juvenile leaf bases, the bark beginning to separate into large scales containing several decurrent leaf bases and flaking off after the third year, pale green, purple or red-brown, glaucous the first year, becoming dark red-brown, then dark brown; **branches** in regular whorls, long, slender, stiff, horizontal, sometimes slightly pendulous; **bark** 1.5-2.5 cm thick, with distinct fissures and large, irregular, scaly plates covered with small, closely appressed scales, light cinnamon-red; **crown** broadly conical, rounded or truncate; **trunk** up to 1 m in diameter, slightly tapering, often clear of branches for at least half its length, but free-standing wolf trees common in old fields with widely spreading lower branches and branch stumps; **tree** 30-40 m tall; **root system** with a very deep taproot, even in mature trees ($2n = 24$).

Importance: This is an important lumber tree of the southeastern United States. The wood of shortleaf pine is heavy, hard, strong, coarse-grained and resinous, used extensively in house construction and furniture manufacturing. The tree is planted for reforestation, in large plantations for production of pulp, and as a lawn or park tree in the south. Although not particularly fire resistant, *P. echinata* coppices up from the roots and stumps in burned-over areas. It is a major element in old-field succession over a wide portion of its range.



3. *Pinus rigida* Miller

Common Names: pitch pine, torch pine, sap pine, yellow pine, southern pine, black Norway pine, candlewood pine

Type Description: Miller, Gard. Dict. ed. 8, no. 10, 1768

Origin: Native to eastern North America

Habitats: Dry, rocky soil, gravelly uplands and sandy plains. Common on glacial soils, thriving in pine barrens and coastal dunes, often on sites of former glacial lake shores in upstate New York, the relative abundance depending on repeated fires and availability of poor soils. Without periodic fire, replaced by white pine or hemlock (oaks in more southern climates)

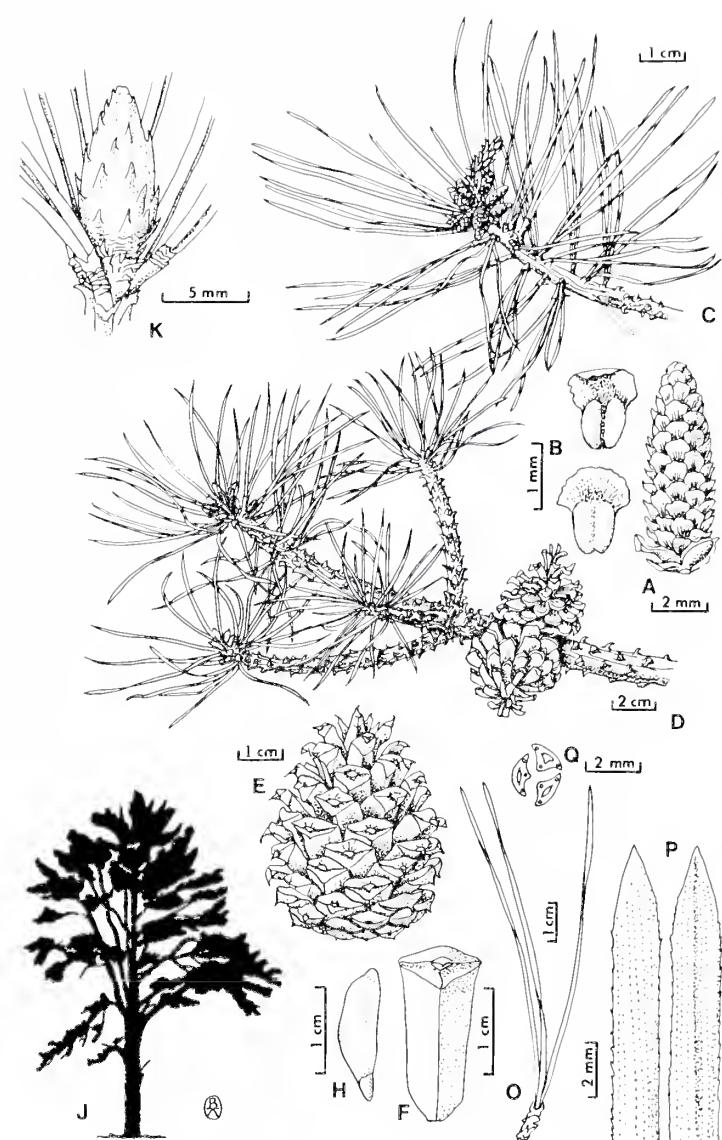
Habit: A small to medium-sized tree with horizontal branches, forming an open, wide, rounded or irregular crown, the trunk clear of branches in the lower third, or with well-developed lower branches, sometimes forming "skirts" at ground level in beach habitats. The trees are often wind-swept, with wand-like, flagging branches, especially in pine barrens, but trees may appear more uniform, less gnarled and contorted on more fertile soils

Pollination: April-May

Mature Cones Opening: Sporadically after 2 seasons

General Distribution: Southeastern Maine west to eastern Ontario, south to northwestern South Carolina, northern Georgia, eastern Tennessee, eastern Kentucky and southeastern Ohio; disjunct in central North Carolina and central and western Kentucky

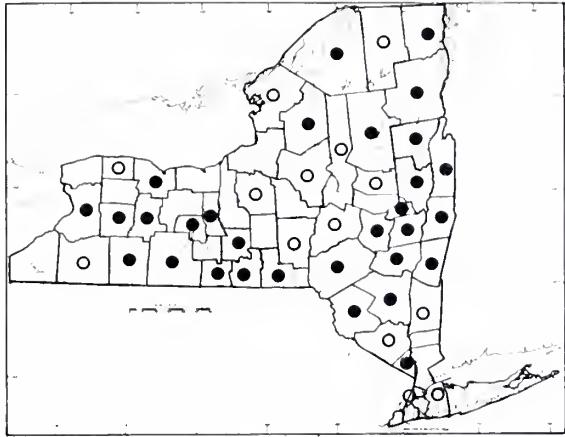
Description: monoecious; female cones solitary or 2 (-4), first appearing at the apex of the previous year's growth on lateral branchlets, erect prior to pollination, becoming horizontal or projecting at right angles from the branchlet, ovoid to subglobose, 4.5-7.0 (-10) cm long, (3-) 4-6 cm wide, green prior to becoming red-brown at pollination, then light brown and shiny, finally weathering gray, serotinous or non-serotinous, persistent as long as 12 years; peduncles 7-10 mm long, 3-6 mm in diameter, scaly; female cone scales about 100, oblong, sometimes obovate, the upper ones ascending, the lower horizontal, reflexing with age, slightly incurved along upper margins near the apex, slightly bulging on lower margins just below the middle, 12-25 mm



long, 8-11 mm wide, light brown to red-brown on the adaxial surface, dark red-brown or dark brown on the abaxial surface; **apophysis** asymmetrically rhombic, 7-12 mm wide, light brown to yellow-brown; **umbo** truncate, 2.5-4.0 mm wide, pungent, armed with a stiff, straight or curved, persistent prickle, the prickle 1-2 mm long, projecting outward or downward; **seeds** about 4 mm long, 2 mm wide, acute at the base, obliquely angled and acute at the apex, thick, rounded on the sides, roughened, black, sometimes mottled brown. **wing** ovate-oblong, 10-13 mm long, 4-5 mm wide, broadest below the middle, gradually narrowed to an oblique apex, pale brown; **male cones** about 20, spirally arranged in a tight cluster on the basal 2-3 cm of the first year branchlet, oblong-cylindrical, (8-) 15-20 (-30) mm long, 4-6 mm wide, red-brown, deciduous in the first year; **sterile scales** 4-8, ovate, 3-5 mm long, acute, red-brown with darker brown midribs, basal scales long-acuminate; **male cone scales** about 150, spirally arranged, about 2 mm long; **lamina** flabellate, about 1 mm long, 1.0-1.5 mm wide with rounded apex, margins minutely denticulate, red-brown, white or transparent at the margins; **microsporangia** about 1 mm long, 1-1.2 mm wide; **juvenile leaves** strongly decurrent, soon drying and reflexing or rolling back with age, linear-lanceolate, 7-8 mm long, long-acuminate, red-brown, margins transparent and often fringed; **adult leaves** almost always 3 to a cluster, each twisting about one complete turn over its length, directed forward past the apex of the spur, often parallel to the branchlet or long shoot, spreading and becoming nearly perpendicular with age, rigid, (5-) 8-10 (-13) cm long, 1.0-1.5 mm wide, acute, light green, margins and midrib serulate, persistent 2-3 years, resin canals (2-) 3-4 (-7), median, **adaxial surface** with a sharply raised, minutely serrulate midrib (or angle) and 12-15 rows of stomata, **abaxial surface** rounded to convex with about 13 rows of stomata; **sheath scales** 9-10, imbricate, acute, basally light green, apically light red-brown, the transparent margins fused and encircling the spur and base of the adult leaves, the basal 3-4 scales ovate, 2-5 mm long, mostly with only the basal margins fused, other scales ovate-lanceolate to lanceolate, 5-10 mm long, margins fused their entire length; **sheath** usually about 5 mm long to the point where it meets the branchlet at the base of the spur shoot, black with ragged, membranous fringes; **terminal buds** sometimes concealed by the leaves, ovoid, oblong-ovoid or oblong, obtuse or acute, 5-16 mm long, the lateral buds usually smaller, obtuse or acute, resinous, red-brown, the long transparent fringes of the scale margins giving the bud a lighter, sometimes hairy appearance; **bud scales** appressed, only their tips slightly spreading, ovate, acute, 3-4 mm long, red-brown, margins scarious, fringed; **branchlets (long shoots)** stout, 3-6 mm in diameter, orange-brown the first year, becoming brown the second year, dark brown, gray-brown or black thereafter, roughened from the persistent base of the juvenile leaf or the juvenile leaf itself, narrowly grooved, at first from the decurrent juvenile leaf bases, becoming broader, sometimes darker or gray, the decurrent leaf bases eventually separating into scales that flake off; **branches** in regular, distant whorls, horizontal, ascending or pendulous, rigid, stout, thick, short, gnarled and contorted with age; **bark** 2-4 cm thick, thin, with red-brown, plate-like scales when young, later deeply fissured into flat, scaly, anastomosing ridges that separate into thin or thick, dark red-brown scales; **tree** up to 25 m tall, with horizontal branches forming an open, wide, rounded or irregular **crown**; **trunk** up to a meter in diameter and often clear of branches in the lower third, but often with adventitious sprouts; **root system** relatively shallow, but with a taproot when young ($2n = 24$).

Infraspecific Variation and Hybridization: Cones may be serotinous or not, depending on fire history of the habitat. Variation may be significant between individuals, including fire-adapted features and leaf length and spacing. Pitch pine hybridizes naturally with *P. taeda* L. (loblolly pine), *P. serotina* Michx. (pond pine) and *P. echinata* elsewhere, but hybrid trees have not been reported from New York State. Most growth forms of *P. rigida* can be attributed to edaphic considerations and wind and winter ice damage, with the likely exception of diminutive trees of the "Dwarf Pine Plains" in the pine barrens of New Jersey, Suffolk County, Long Island, New York, and the Shawangunk Mountains in Ulster County. A case has been made for a genetic component that is at least partially responsible for the consistent differences displayed in these dwarf trees (Good and Good, 1975; Ledig and Fryer, 1974; Little, 1972; Olsvig, 1980; Olsvig *et al.*, 1979). These characteristics include a greater percentage of serotiny in the female cones, contorted stems with prostrate branches, short annual internodes, and massive root crowns (Olsvig, 1980). The adaptation for survival to frequent fires is obvious in contrast with typical pitch pines, which are also fire-adapted but for less frequent occurrence of fire. A formal botanical variety for dwarf pitch pine has yet to be described and named. A few cultivated varieties popular in dwarf conifer gardens have recently been developed and named.

Importance: Pitch pine was historically important in production of charcoal, and the wood was used as a fuel. The light, soft, weak, brittle, coarse-grained wood is durable and rot-resistant. It has been used in manufacture of vessels, flooring, water wheels, aqueducts, sills and framing, as well as for rough lumber and crate-building material. Lampblack, tar and turpentine have been derived from the resin, and the knotty resin-filled branches were used as torches and fire-starting wood by early Americans. Pitch pine has little importance as an ornamental. The trees do not compete well with most forest species, but easily tolerate poorer soils, and can become weedy and quickly dominant in open, oak-pine associations. Their ability to resist fire, to coppice up after burns and to withstand salt spray and accumulation are remarkable among conifers. With progressing development in New York State, scattered pitch pines remain as lonely representatives of former pine-barrens vegetation, and the species is becoming well known as a weedy colonizer of recently disturbed, poor sites.



4. *Pinus resinosa* Aiton

Common Names: red pine, Norway pine, hard pine, Canadian pine

Type Description: Aiton, Hort. Kew., vol. 3, p. 367, 1789

Origin: Native to eastern North America

Habitats: Scattered in coniferous or hardwood forests, occasionally forming open groves or rarely in pure stands, thriving on gravelly ridges, on sandy plains and other areas of poor soil; rarely found in low, wet ground. A tree that can not compete well with brush or white pine on most sites. In New York State, common on sandy soils near the Adirondacks, less frequent on dry, flat areas or benches in the central and, rarely, the western part of the State. Also a component of pine barrens vegetation in Clinton County. It may be more common in parts of the State today because it was massively planted for timber and reforestation purposes during much of the 20th Century

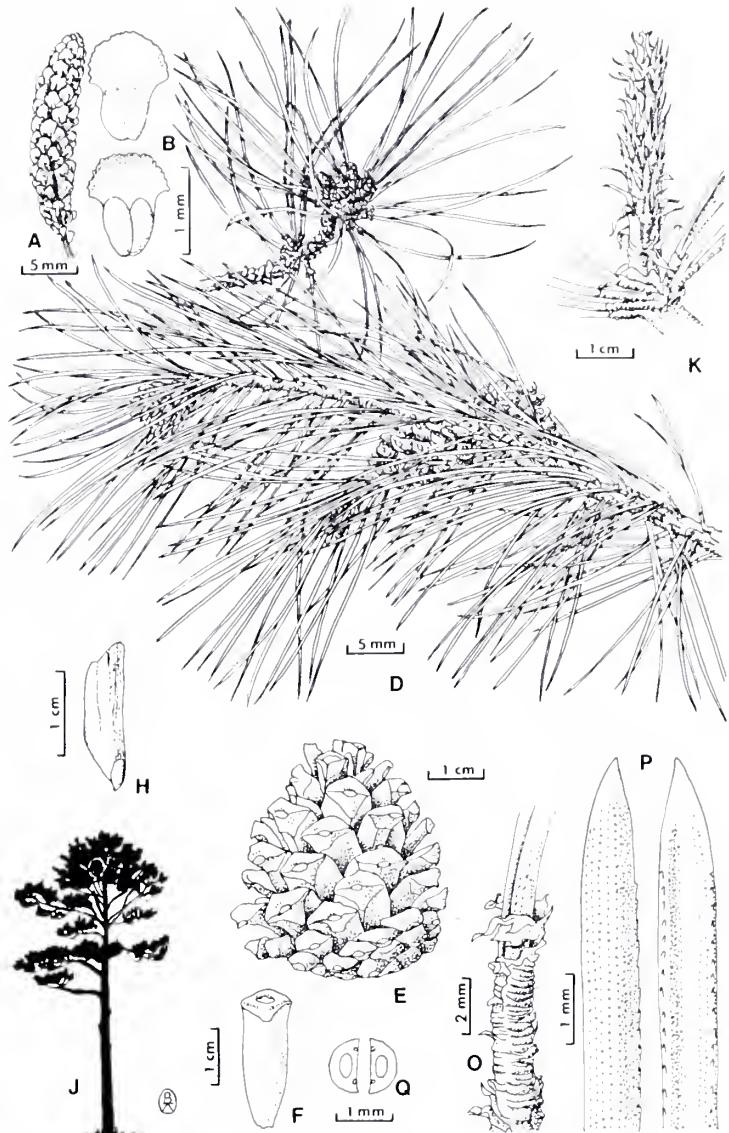
Habit: A medium-sized tree with stout, spreading, sometimes pendulous branches that form a broad, often round-topped crown, the trunk straight with little taper, usually devoid of branches for at least half its length when growing in forest habitat

Pollination: April-June

Mature Cones Opening: September of the 2nd season

General Distribution: Nova Scotia west to southern Manitoba, south to northern New Jersey, northern Pennsylvania, northern Michigan, Wisconsin and eastern Minnesota; disjunct in Newfoundland, West Virginia and northern Illinois

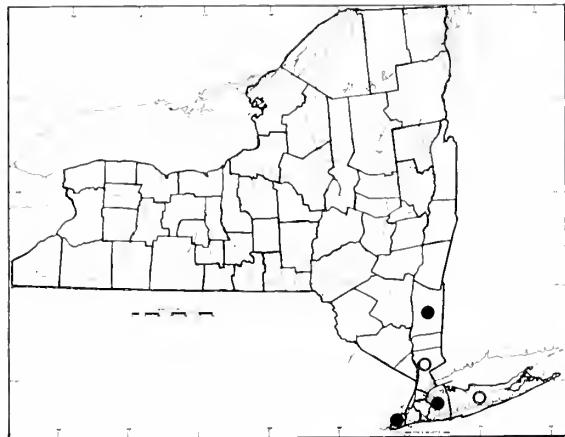
Description: **monoecious;** **female cones** solitary or in whorls of 2-3 near the apex of the current year's growth, upright, becoming horizontal or slightly pendulous following pollination, narrowly conical becoming ovoid or subglobose when mature, symmetrical, about 4 (3.5-5.5) cm long, 3.5-4.0 (-5) cm wide, red and showy prior to pollination, then red-brown, becoming dark brown weathering to gray, usually persistent for only one year after opening; **peduncles** 4-5 mm long, soon concealed by reflexed basal cone scales; **female cone scales** 60-70, oblong or slightly narrowed towards the apex, slightly incurved just below the apex, 16-19 mm long, 8-12 mm wide, **adaxial surface** concave and light brown becoming gray with age, **abaxial surface** keeled and dark brown to almost black, the upper or apical scales narrower, the ultimate pair underdeveloped and not separating, thus together cylindrical, the unopened basal scales nearly half the total number of scales and much smaller; **apophysis** broadly rhombic, 5-7 mm high, 8-12 mm wide, shiny, light brown, with a pronounced (or inconspicuous) transverse ridge or line; **umbo**



raised or depressed, unarmed, truncate, circular or transversely elliptical; **seeds** ovoid to obovoid, 3-5 mm long, 2-3 mm wide, the apex rounded, base gradually and slightly narrowed, obtuse, the sides rounded, brown to dark brown, mottled black, **wing** oblong or ovate, apex often obliquely narrowed, rounded, light brown, with dark brown striations; **male cones** 40-60 in a tight, spiral cluster covering the basal 2.0-3.5 cm of the first-year branchlet, (cones) at first erect, then horizontal and pendulous, ovoid, becoming oblong-cylindrical, 6-7 mm long and 4-5 mm wide just prior to pollen release, finally becoming nearly 15 mm long and 4 mm wide, red-brown, becoming brown, twisted after pollen dispersal, often persistent into the second year; **sterile scales** 4, ovate, about 3 mm long, 2.5 mm wide, the basal pair swollen, keeled and indurate; **male cone scales** about 150, spirally arranged, 1.7-2.0 mm long, red-brown; **lamina** flabellate or suborbicular with cordate base, about 1 mm long, 1.0-1.2 mm wide, the apex rounded, minutely laciniate or erose, red-brown with transparent margins; **microsporangia** 1.0-1.5 mm long; **scarious juvenile leaves** about 1.5 cm long and 5 mm wide at the base, long acuminate-aristate, red-brown with transparent margins, soon deciduous, leaving a hardened, persistent decurrent base, the peg projecting 1-2 mm from the branchlet; **adult leaves** almost always 2 per cluster, (7.5-) 11-15 cm long, about 1 mm wide, acute, straight, not twisted, flexible, brittle, snapping easily and cleanly when bent, hemispherical in cross section, margins minutely and obtusely toothed, green, deciduous after 2-3 years, resin canals 2, median or marginal, adaxial surface flat with 7-8 rows of stomata, abaxial surface convex with 12-15 rows of stomata; **sheath scales** about 12, light brown to red brown, increasingly transparent, becoming very tightly woven, the basal scale ovate, 3-4 mm long, keeled, indurate, second scale ovate, 3-4 mm long, third and fourth scales ovate, about 5 mm long, fifth, sixth and seventh scales ovate-oblong, about 10 mm long, eighth scale lanceolate-oblong, 14-16 mm long, ninth, tenth and eleventh scales lanceolate, 18-22 mm long, twelfth scale wholly transparent, lanceolate, about 18 mm long; **sheath** 9-12 mm long, ragged at the apex, gray-black; **buds** up to 2 cm long, ovoid, acute or obtuse, resinous, the lateral buds smaller; **bud scales** loosely imbricate, ovate, about 15 mm long, acute, red-brown; **branchlets (long shoots)** stout, 4-8 mm in diameter, roughened by the persistent, obovate or rectangular, truncate, decurrent, raised bases of the juvenile leaves, these separating into loose scales by the second year and beginning to flake off by the close of the third year, red-brown becoming dark brown or gray; **branches** stout, slightly ascending, then horizontal or sometimes pendulous; **bark** 1.5-3.0 cm thick, shallowly fissured into broad, flat ridges that peel off as thin scales, red-brown, the scales gray; **crown** broad often round-topped, with stout, spreading or ascending, sometimes pendulous branches; **trunk** 75-100 cm in diameter, straight, often devoid of branches for more than half its length; **tree** 25 (-50) m tall; **root system** spreading, with a strong taproot when young ($2n = 24$).

Infraspecific Variation: The growth of red pine is remarkably uniform, varying little whether in the open or in closed forest stands, and with little variation in its coarse needles, stout twigs and cone size and shape. Determination of the cultivated or wild origin of a given tree is sometimes rather difficult, since red pine can also be confused with the often-cultivated *P. nigra*, Austrian pine, which has similar leaves, cones and growth habit. Austrian pine, however, has leaves that merely fold when bent instead of snapping in two. It also has white or paler buds and lacks the red, flaking bark of the upper trunk and branches of red pine.

Importance: The light, hard, very close-grained lumber of red pine is used for general construction, crates, boxes, for pulp, and the logs for cabin and house construction. This species is planted for reforestation and sometimes for hedges, but its rapid growth makes it less suitable for the latter. Its coarse, heavy growth habit makes it an undesirable Christmas tree, and there is little use for the tree as an ornamental, although a few cultivated varieties have been developed.



5. *Pinus virginiana* Miller

Common Names: Virginia pine, Jersey pine, scrub pine, spruce pine

Type Description: Miller, Gard. Dict., ed. 8, no. 9, 1768

Synonym: *P. inops* Aiton

Origin: Native to southeastern North America

Habitats: Scattered in association with hardwoods, some trees persisting in old fields, early successional pure stands remaining in areas of sterile sand, clay or poor rocky soils. Usually competitive with overtopping species, these trees can grow on well-drained, rocky soils, but they are usually found on sand in their limited southeastern New York distribution

Habit: Small tree with long, slender horizontal or pendulous branches in widely spaced irregular whorls, forming a flat-topped or conical, irregular crown, the trunk small and devoid of branches for more than half its length even in open conditions

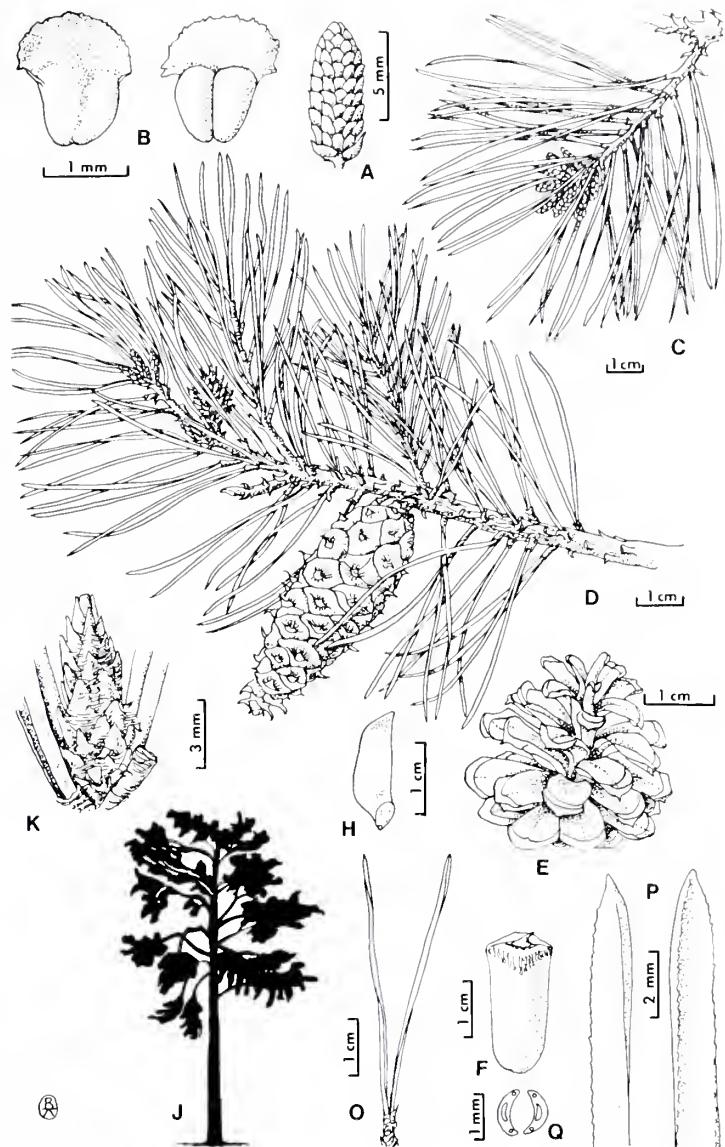
Pollination: April-May

Mature Cones Opening: September of the 2nd season

General Distribution: Southeastern New York, west to southeastern Ohio, south to northern South Carolina, northern Georgia, northern Alabama, northeastern Mississippi, western Tennessee and central Kentucky; disjunct in eastern North Carolina and southeastern Indiana

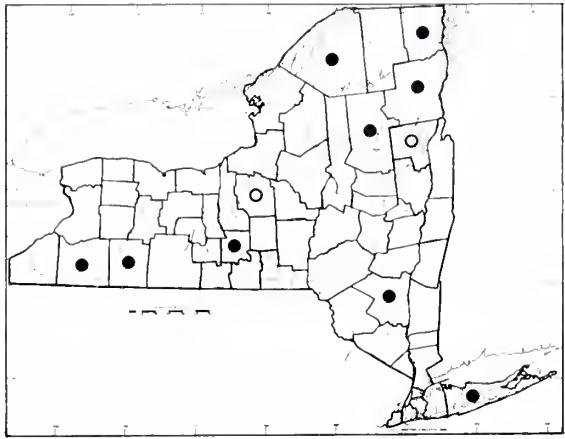
Rarity Status: This species is ranked E (endangered) under New York State law. The New York Natural Heritage Program rank is G5 S1 (globally secure, 5 or fewer extant State occurrences)

Description: **monoecious; female cones** solitary or 2-3 in a whorl near the middle of the first-year branchlets, horizontal, symmetrical, globose or subglobose prior to pollination, becoming ovoid, then conical, about 15 mm long, 10 mm wide prior to pollination, becoming (4-) 5 (-7) cm long 3.2-4.4 cm wide after final opening, dark red-brown or yellow-brown, then green tinged with red or pink, red-brown, finally dark brown or gray-brown, often lustrous, persistent 3-4 years after maturing; **peduncle** rough, scaly, about 5 (-10) mm long although obscured by the basal scales; **female cone scales** 100-120, the basal 1/3-1/2 never opening, oblong, 16-20 mm long, 8-12 mm wide, the basal and apical scales smaller, the uppermost pair not separating and therefore cylindric, the adaxial surface concave, pale brown beneath the wings of the seeds, turning dark brown or gray with age,



the abaxial surface broadly keeled, dark red-brown or purple-brown; **apophysis** rhombic, only slightly thickened, 4-5 mm high, 5-10 mm wide, the transverse ridge sharp and pronounced on the middle and upper scales; **umbo** armed with a sharp, straight broad-based, 2 (-4) mm long prickle that is deciduous or persistent for several years; **seeds** irregularly oblong to obovate or nearly ovoid, 4-5 mm long, 2.0-2.5 mm wide, slightly narrowed at the obtuse base, rounded at the apex and sides, pale brown, sometimes mottled black, surface rough, **wing** oblong or obovate, about 1 cm long, 5 mm wide, rounded or obtuse at the apex, obliquely pointed at the base, the brown striations inconspicuous; **male cones** crowded in clusters of 20-25 covering the basal 1 cm of the first-year branchlet, globose and 2 mm in diameter when young, becoming oblong-cylindrical, 10-13 mm long, 3-4 mm wide, red-brown, deciduous the first year, sometimes persisting into the second year; **sterile scales** 8, ovate to oblong, red-brown with transparent margins, the basal pair indurate, 2-3 mm long, the middle 4 about 4 mm long, the upper 2 about 5 mm long; **male cone scales** 60-80, about 1 mm long, 0.5-0.7 mm wide with sporangia closed; **lamina** flabellate or nearly orbicular, about 1 mm long, 1 mm wide, minutely laciniate, red-brown with transparent edges; **microsporangia** about 1 mm long; **scarious juvenile leaves** lanceolate, 3-4 mm long, deciduous the first year, each leaving a hardened, decurrent, raised, persistent leaf base; **adult leaves** almost always 2 per cluster, directed forward along branchlet in the first year, later at right angles, scattered along branchlet, usually not crowded, stout, stiff or rigid, twisting about 1.5 turns, 4-8 cm long, 1.0-1.5 mm wide, acute, incurved, minutely serrulate, the teeth closer together and spreading more toward the apex, bright green to gray-green, fragrant, persistent 2-4 years, resin canals 2, median, **adaxial surface** concave, with 12-15 rows of stomata, **abaxial surface** broadly convex, with 15-18 rows of stomata; **sheath scales** 8, ovate-oblong, the basal two about 3 mm long, slightly swollen at the base, not indurate, the third about 4 mm long, the middle 3 about 6 mm long, the 7th about 7 mm long and almost completely transparent, the 8th about 4 mm long and striated red; **sheaths** about 6 mm long the first year, 3 mm long thereafter, becoming gray or blackened; **buds** oblong, 6-12 mm long, about 2 mm wide, lateral buds often smaller, sharply acute, dark red-brown to dark brown, very resinous; **bud scales** many, imbricate, tightly appressed, ovate, about 3 mm long, acuminate, the tips eventually spreading, red-brown with transparent fimbriate margins, those of the outer scales interwoven around the bud; **branchlets (long shoots)** slender, stiff or flexible, 1-5 mm in diameter, roughened by the persistent raised decurrent bases of the juvenile scales, these forming ridges and grooves or striations that become thin, rectangular scales, flaking off in the fifth or later years, purple and glaucous the first year, becoming light brown, gray brown or dark brown; **branches** long, slender, horizontal, sometimes pendulous, in widely spaced irregular whorls; **bark** 6-12 mm thick, shallowly fissured into small, scaly scales, smooth on young trunks or branches, dark red-brown to brown; **crown** flat-topped, conical, irregular due to the long slender horizontal or pendulous branches; **trunk** rarely more than 50 (-90) cm in diameter, often devoid of branches for more than half its height, even in open conditions; **tree** 10-15 (-30) m tall, bushy; **root system** with a taproot when young, spreading ($2n = 24$).

Importance: The soft, weak, brittle wood of Virginia pine is coarse-grained and durable, and has received limited use in production of charcoal, railroad ties, rough lumber and, more recently, pulp. The seeds can be an important source of food for wildlife. This species has little value as an ornamental, although it has been used, within its broader range, for reforestation of poor lands.



6. *Pinus banksiana* Lambert

Common Name: jack pine

Type Description: Lambert, Deser. of the Genus *Pinus*, p. 7, 1803

Synonym: *Pinus divaricata* Gordon

Origin: Native to northern North America

Habitats: Dry, sandy, often poor soils, native to New York only in the northern counties, the most prominent examples being a few pure stands in the sandstone barrens of the flatrock area of Clinton County. Occasionally escaped from cultivation, and native elsewhere on sand dunes and in barrens, mixed with scrub oaks and other pine-barren vegetation, rocky ridges, less frequently in low-lands and boggy plains.

Habit: Small tree in the southern part of its range, sometimes shrubby, with slender spreading branches forming an open, broadly conical to pyramidal crown, on poor soils the crown often stunted, irregular, the branches large, spreading, with an irregular, gnarly appearance. They can grow on extremes of calcareous or acidic, fertile or sterile soils (Baldwin, 1979)

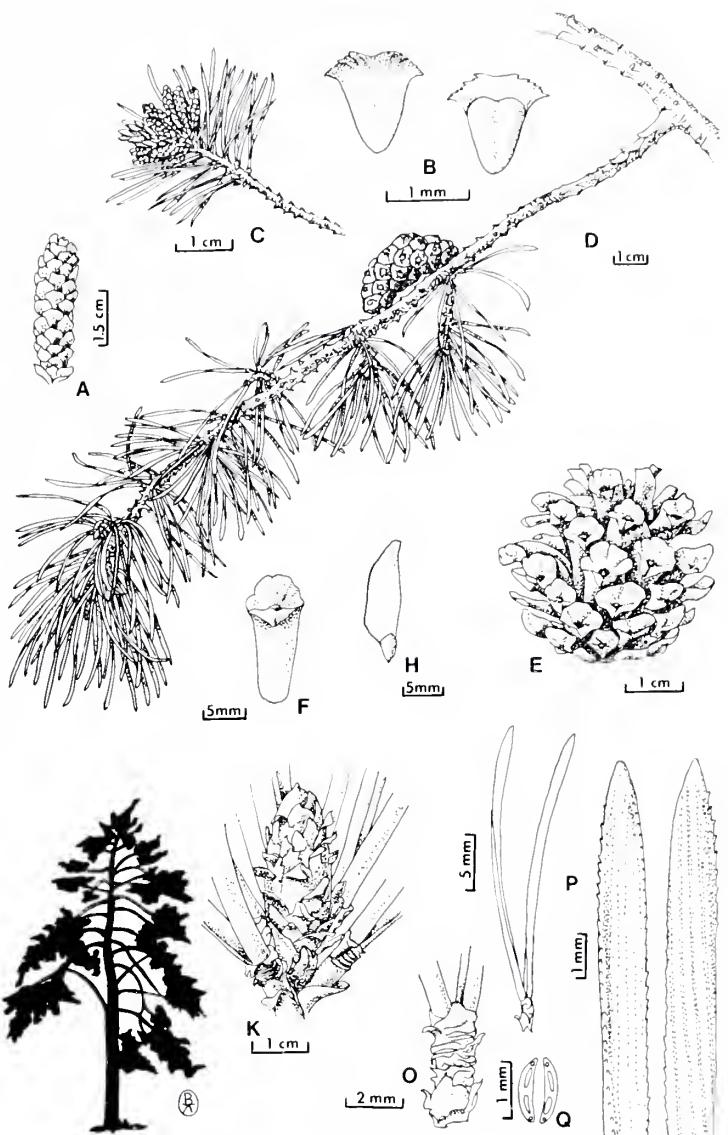
Pollination: May-June

Mature Cones Opening: September of the 2nd season (partially); often remaining closed for years, opening further after fire

General Distribution: Nova Scotia west to Yukon, south to Quebec, Ontario, northern and western Michigan, northwestern Indiana, northern Illinois, Wisconsin, eastern Minnesota, central Manitoba, northern Saskatchewan and northern Alberta; disjunct in northern parts of New Hampshire, Vermont, New York, Illinois and Minnesota

Rarity Status: This species has a State ranking of R (rare). The New York Natural Heritage Program ranks it G5,S3. This means that the species is globally secure, but populations have been reported no more than 15 times in New York State (up to 20 times with known cases of extirpation)

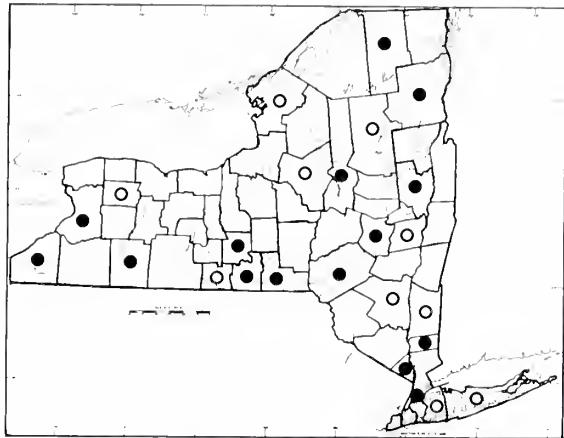
Description: **monoecious; female cones** solitary, or in pairs at the base of the year's growth, often present on very young trees, erect, ascending or becoming horizontal, conical or ovoid, asymmetric, with an oblique or gibbous base, often curving into a broad, contorted C-shaped outline and becoming pressed against the branchlet, partially serotinous, 2.5-5.0 (-6) cm long, 2-3 cm



broad when open, dark purple at pollination, then dull purple or green, lustrous, becoming yellow-brown to brown when open, finally weathering dark brown or gray, often remaining at least partially closed and persisting for 25-30 or more years; **peduncle** 1-2 mm long, soon obscured by the reflexed bases of the lower cone scales; **female cone scales** about 100, the lower 10-20 remaining closed, oblong with rounded-truncate apex, 10-16 mm long, about 6 mm wide, concave, light brown to red-brown beneath the wings of the seed on the adaxial surface, broadly keeled and dark red-brown on the abaxial surface, glabrous; **apophysis** rhombic or flabellate to suborbicular, 7-8 (-11) mm in diameter, only slightly thickened or sometimes prominently thickened into a large hump or mound, the transverse line a sharp ridge or inconspicuous, yellow-brown; **umbo** unarmed; **seeds** obovate, about 3 mm long, 2 mm wide, gradually narrowing to the acute or obtuse base, roughened, pale brown to red-brown, mottled black, reticulate beneath the wing, which is oblong-elliptic, broadest in the middle, 8-10 mm long, about 4 mm wide, pale brown, the striations dense to very dense or solid at the apex; **male cones** usually 25-35 per cluster, covering the basal 1.0-1.5 cm of the first-year branchlet, straight or sometimes twisted, oblong-cylindrical, 6-8 mm long, 1.5-2.5 mm wide, red-brown, usually falling by the end of the first year; **sterile scales** 6, ovate, increasing in length from base upward or outward, 2-3 mm long; **male cone scales** 75-100, about 1.2 mm long; **lamina** semi-orbicular or flabellate, 0.8 mm long, 1.0-1.2 mm wide, the apex rounded, red-brown with transparent, minutely laciniate margins; **microsporangia** about 1 mm long, 0.5 mm wide; **scarious juvenile leaves** ovate-lanceolate, 1.5-3.0 mm long, red-brown with transparent margins, deciduous the first year, leaving a persistent, raised, decurrent base on the branchlet; **adult leaves** almost always 2 per cluster, stout, rigid, acute, straight or twisted 1/4-1/2 a turn, 2-4 cm long, 1.5-2.0 mm wide, margins serrulate and rough to the touch, bright green, persistent 2-5 years or occasionally longer, resin canals 2, median, **adaxial surface** flat or slightly concave with 7-12 rows of stomata, **abaxial surface** broadly keeled with 10-16 rows of stomata; **sheath scales** 8, the basal scale ovate, 2 mm long, indurate, the next 4 scales ovate or ovate-oblong, 3-5 mm long, the upper 3 scales obovate or oblong, 6 mm long, 2 of them nearly or completely transparent; **sheaths** 1.5-2.5 mm long in the second year, gray or black, ragged; **buds** ovoid, 3-4 mm long, the lateral buds usually smaller than the terminal ones, obtuse or with a rounded apex, pale brown, very resinous, the amber resin often completely covering and obscuring the bud scales; **bud scales** many, appressed with spreading tips, ovate-lanceolate, 2-3 mm long, acuminate; **branchlets (long shoots)** 1-5 mm in diameter, roughened by the persistent juvenile leaves or leaf bases, yellow-green or yellow-brown, changing to purple or purple-brown the first year, red-brown with striations from decurrent juvenile leaf bases the second year, gray or dark brown with thin gray flaking scales formed by the decurrent leaf bases in later years; **branches** long, horizontal, dark brown, often gnarly or twisted; **bark** thin, to 2 cm thick only on older trees, shallowly fissured into narrow ridges covered with scales, dark gray-brown, sometimes tinged with red; **crown** open and broad to conic, with slender spreading branches or stunted, irregular; **branches** large, spreading, often forming distorted, gnarly specimens; **trunk** 25 (-60) cm in diameter, straight, sometimes free of branches for 1/2-2/3 its length, but usually with lower branches and branch stumps; **tree** usually 9-12 (-25) m tall, ours often shrubby; **root system** widely spreading beyond the crown, moderately shallow, with a taproot when young ($2n = 24$).

Infraspecific Variation: A short-lived tree (usually less than a hundred years), jack pine does not grow straight and tall except sometimes under competition in a forest stand. Otherwise the tree is gnarled, contorted and stunted in icy and wind-blown habitats. Leaf length, branchlet and branch length are also affected by severe conditions and apparently also by acidity of the soils. Cone size remains remarkably constant, but the degree of serotiny is variable, often with a high percentage of open cones present on a tree.

Importance: Jack pine is an important early successional species. It can colonize rapidly after fire when its serotinous cones open and scatter their seeds. Fire is not required for cones to open, but fire and other disturbances do stimulate cone opening as well as producing conditions needed to reduce competition for jack pine establishment and persistence (Baldwin, 1979). Its light, soft, weak, close-grained wood is used occasionally for railway ties, posts, boxes, lath, barrel staves and pulp. With the exception of several dwarf cultivated varieties, the species is not used as an ornamental.



7. *Pinus sylvestris* L.

Common Names: Scotch pine, Scots pine, Norway pine

Type Description: Linnaeus, Species Pl. II, p. 1000, 1753

Origin: Native to northern Eurasia

Habitats: Open fields, pastures, edges of woods wet or dry soils. Escaping cultivation and planted widely throughout the State

Habit: Small to medium-sized tree with the trunk usually twisted and contorted, clear of branches in the lower half of older trees of plantations, and an irregular, open, crown with yellowish to bright orange, flaking bark highly visible and leafy branches well scattered

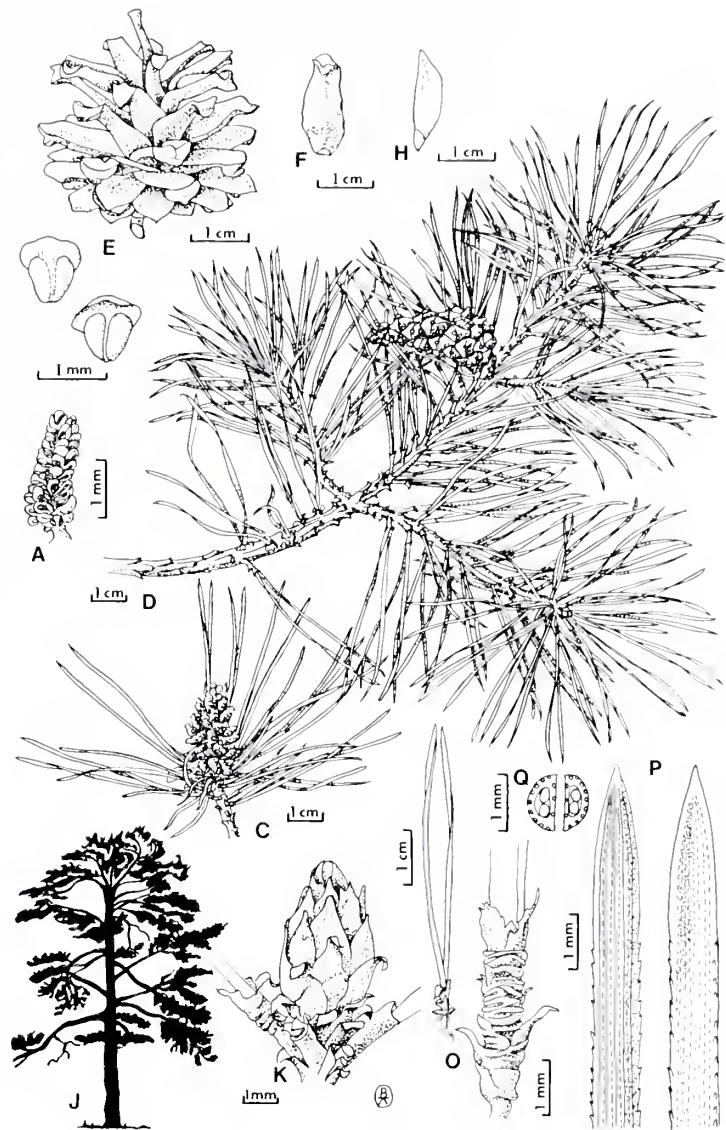
Pollination: May-June

Mature Cones Opening: September of the 2nd season

General Distribution: Native to Eurasia, escaping from cultivation widely in North America: from New Brunswick to Ontario, Nebraska, Iowa and Indiana, south to New Jersey, Virginia and Ohio.

Note: The number of specimens and observations of Scotch pine in the State may be misleading, due to frequency of planting. Establishment of *P. sylvestris* as an escape from cultivation is apparently infrequent.

Description: monoecious; **female cones** borne in pairs or whorls at the apices of the branchlets toward the end of the first season's growth, more visible at the bases of second year branchlets, pendulous or horizontal, ovoid the first year, then conical when closed following pollination, ovoid or slightly ovoid-oblong when mature and opening for the second time, symmetrical or slightly asymmetrical, 3-4 (-6) cm long, 2.5-4.0 (-5.0) cm wide, green or greenish-brown, becoming brown, persistent for several years after maturing; **peduncle** scaly or roughened, 10-12 mm long; **female cone scales** about 80, spirally arranged, oblong, concave, slightly incurved near the rounded or obtusely angled apex, 15-20 mm long, 8-10 mm wide, the apical 2-4 scales nearly terete, 2-4 mm wide, basal scales smaller and mostly not opening, the adaxial surface concave, brown to red-brown, abaxial surface broadly keeled and dark brown; **apophysis** rhombic, 7-10 mm wide at its widest point, light brown or yellow-brown, those at the base of one side of the cone often thicker, protruding, rounded, mound-like or conical; **umbos** armed initially with a prickle about 1 mm long, later truncate, emarginate or crinkled; **seeds** ovoid, 4-5 mm long, about 2.5 mm wide, rounded at the apex, acute at base, black or brown, **wing** sail-shaped or obovate, 10-16 mm long, 4-7 mm wide, obliquely angled and obtuse at the apex, wedge-shaped at base, brown, often partially striated black; **male cones** 40-70, spirally arranged in a crowded cluster



covering the basal 1.5-3.0 (-4.0) cm of first-year branchlets, oblong-cylindrical to subglobose, 4-14 mm long, 1.5-2.5 mm wide, red-brown to light brown or yellow at pollen release; **sterile scales** 4, the basal pair ovate, the upper pair oblong or spatulate, 3.0-3.5 mm long, pale brown to transparent with darker midribs; **male cone scales** 70-100, spirally arranged, crowded, 0.9-1.3 mm long, light brown; **lamina** flabellate, projecting only 0.2-0.4 mm to the side; **microsporangia** 0.8-0.9 mm long; **scarious juvenile leaves** lanceolate, long-acuminate, 7-8 mm long 1.5-2.0 mm wide at base, red to red-brown, the margins transparent, fringed, soon reflexed and coiling back, deciduous prior to expansion of the adult leaves leaving a long-persistent raised leaf base about 1 mm long and decurrent on the branchlet; **adult leaves** almost always 2 per cluster, at right angles to, or directed forward along the branchlet, coarse, stiff, mostly 4-9 cm long, 1.5-2.0 mm wide, straight or twisted 1/2 turn along the full length, minutely serrulate, light green, yellow-green or blue-green, usually persistent for 3 years; resin canals 9-11, marginal, **adaxial surface** with margins slightly recurved, the stomata in 8-12 longitudinal rows, **abaxial surface** broadly convex, with 10-18 rows of stomata; **sheath scales** 6-8, completely concealing the spur, the margins fused nearly their full length, the apex fringed, red-brown, transparent or only the margins transparent, the basal pair ovate, 2-3 mm long, the third scale about 5 mm long, the remainder 2-3 times as long as wide, 7-8 mm long; **sheaths** about 5 mm long, light gray becoming black, more tightly packed around the base of the leaves and the spur, the apex increasingly fringed and ragged with age; **buds** oblong, sometimes ovoid-oblong, 4-8 mm long before leaves begin to expand, terminal buds much larger than the lateral, resinous, red-brown, usually shaggy due to the reflexed or spreading apices of the scales, the shagginess sometimes obscured by the presence of amber or white resin deposits; **bud scales** numerous, ovate-lanceolate, about 8 mm long, 2-3 mm wide, pressed tightly together but the apex of the outer scales of several series reflexed and spreading or coiled, red-brown, margins scarious or fringed; **branchlets (long shoots)** stout, rigid on young trees or new growth, 3-6 mm in diameter, roughened by the persistent, raised juvenile leaf bases, the resulting grooves becoming gray, about 0.5 mm wide in the second year, light brown, greenish-brown or gray-green, yellow-green the first and second year, brown or gray the third year; main **branches** horizontal or slightly ascending, short and twisted on older trees, brittle, soon deciduous after dying; **bark** thin, to 3 cm thick on older trees, bright red, sometimes laced with yellow or light green, with flaking gray scales, becoming ridged and fissured at the base of older trees; **crown** full, conical and symmetrical as a young tree, irregular and open with age due to easily broken-branches, the bright red bark highly visible; **trunks** usually twisted and contorted, clear of branches in the lower half of the tree, often even in the open; **tree** to 25 m tall; **root system** with a distinct taproot when young, widely spreading ($2n = 24$).

Infraspecific Variation: There is great variety in leaf length and color, as well as growth habit, among trees of this species. Many cultivated varieties have been propagated. The seed source is important for Christmas tree growers in determining desirable leaf color, leaf retention and rapid and uniform growth rate. Several subspecies have been described in Europe, and clinal variation is also known in wild populations there. The leaves can be short and directed at right angles, so as to appear similar to those of *P. banksiana*, especially under stress conditions. Most trees of *P. sylvestris* planted and escaped in eastern North America are short-lived with twisted trunks and much loss of branches, giving them an aspect unlike the taller, straighter, longer-lived trees of Scotland and northern Europe. Trees of this species are distinguished from *P. banksiana* by the distinctive, bright orange, flaking bark of their upper trunks, earlier-deciduous, longer leaves with more resin canals, longer leaf sheaths and juvenile leaf bases that are longer, less-spreading and more rapidly deciduous.

Importance: Scotch pine has been important in eastern North America for reforestation, and as a Christmas tree crop. Its use in ornamental plantings has often included trimming young trees into hedges. Scotch pine is known for its rapid growth, full healthy foliage as a young plant and unusual, orange, flaking bark on the upper trunk and limbs of mature trees. In Europe its lumber and turpentine resin are important commercial products. The wood is durable but soft; most trees grown in North America are short-lived with twisted, misshapen trunks, hence this species has little value for any lumber product except pulp in this country.

2. LARIX

Common Names: larch, tamarack

Authority: Miller, Gard. Dict., abr. ed. 4, p. 744, 1754

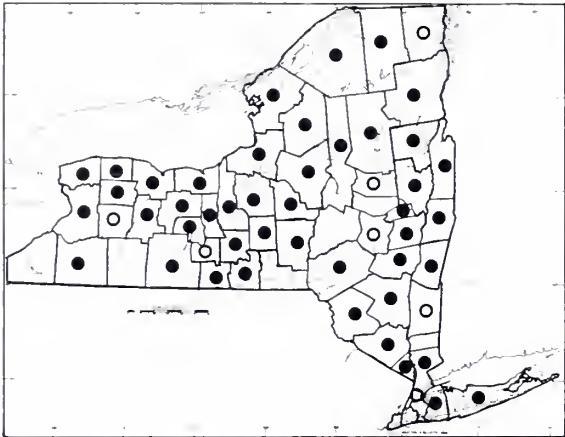
A genus of about 11 species, widely distributed in the Northern Hemisphere. Larch is one of the few conifers (along with *Glyptostrobus*, *Metasequoia*, *Taxodium*, *Pseudolarix*) whose leaves are deciduous the first year, and it is also one of four genera: *Larix*, *Cedrus*, *Pinus* and *Pseudolarix*, that bear their leaves in clusters at the tips of abbreviated branchlets or spurs. There are three North American species, of which *Larix occidentalis* Nutt., western larch and *L. lyallii* Parl., alpine larch, are known only from the Northwest. *Larix laricina* (Duroi) K. Koch, tamarack, the only species native to New York, has by far the broadest range of distribution, and is the larch most easily recognized. When growing in open conditions larch produces tall, straight trees with long, sweeping branches, but they may be dwarf and shrubby in alpine and arctic conditions. Logs and wood of larch are

important forest products, and turpentine is manufactured from the resin. Horticultural use of larch focuses on windbreaks and its use as an ornamental tree with golden yellow leaves in the fall; however, its use is limited by the large space required by the tree's long, horizontal or often pendulous branches. The pendulous branches are also brittle and easily broken off with age, making larch a somewhat less desirable as a lawn tree. *Larix decidua* L., European larch, is the most commonly planted ornamental larch in New York State. It escapes cultivation (Cook, 1939), perhaps to a much greater extent than the number of herbarium specimens would indicate.

Description: monoecious; **female cones** borne terminally on third-year spurs (short-shoots), erect before pollination, then pendulous by the twisting of the peduncle, once again erect when mature, globose, subglobose or oblong, 1.2-4.0 cm long, purple when young, then green finally brown, persistent, usually only until the following year, the short shoot sometimes resuming growth, extending through the cone and elongating past the apex of the cone to become a long shoot; **peduncle** 4-15 mm long, curved, scaly; **bracts** ovate to lance-ovate or oblong, about twice as long as wide, 1.8-2.6 mm wide, light brown to yellow-green, glaucous when young, entire or sometimes erose, quickly reaching full size, thereby longer than, and exserted from the scales when the cone is young, the middle and upper bracts becoming concealed, the bracts of the basal scales broader and swollen at the base, remaining exposed, the midrib extending beyond the tip as a short awn, apex and awn green at pollination, quickly becoming brown, dark brown or purple-brown; **female cone scales** 9-50 (not including 3-4 reduced scales at the base or the greatly reduced, unopened scales at the cone apex), orbicular to flabellate, concave, thin, 7-13 mm in diameter, rose-red before pollination, becoming brown, glabrous, glaucous when young, margins entire to minutely erose or denticulate, at least toward the apex, margin of the apex sometimes emarginate (in *L. decidua*) or undulate (not in ours); **ovules** with a stigma-like development at the micropyle; **seeds** obovoid, rounded at the apex, acute at base, 1-5 mm long, 1-2 mm wide, light brown, lacking resin; **wing** obliquely ovate or sail-shaped, the apex obtuse or acute, 2.5-7.0 mm long, 1.5-4.0 mm wide, pale brown; **cotyledons** 6; **male cones** terminal on second, third and sometimes fourth-year spurs, sessile, compact, globose or nearly so, 3-6 mm in diameter; **sterile scales** about 20-60, ovate to flabellate, mostly 2-4 mm long, 1.5-2.0 mm wide, scarious, red-brown, light brown toward the thin, often rolled or crumpled, often fimbriate margins, sometimes swollen and carinate toward the base; **male cone scales** 30-60, oblong, 1-2 mm long; **lamina** barely evident, 0.1-0.3 mm long, light orange to yellow-brown; **microsporangia** opening longitudinally or obliquely, 0.7-1.3 mm long; **pollen** smooth, large, lacking wings; **leaves** dimorphic; **juvenile leaves** arranged in loose spirals along the long shoots, otherwise quite similar to adult leaves, glaucous at the base, the stomata usually in 1-2 longitudinal rows on each side of the midrib, or sometimes only at the apex, rarely lacking on the adaxial surface and in longitudinal bands of 3-6 rows each on either side of (and equal in width to) the elevated midrib on the slightly concave abaxial surface; **adult leaves** in tight clusters at the tips of spur shoots, 12-50 per cluster, radiating outward and upward from their clustered bases, linear, often somewhat wider in the middle, 2-4 cm long, 0.9-1.6 mm wide, acute, entire, margins often so strongly recurved that the stomatal bands appear sunken into the abaxial surface, stomata conspicuous in spring, but quickly fading, resin canals 2, marginal, the leaves light green, turning a shining, bright, brilliant yellow before falling at the end of the 1st season, **adaxial surface** flattened or with a slightly raised midrib, with 1-2 (3) continuous or interrupted rows of stomata on each side of the midrib, 2-3 rows on each side at the extreme apex, **abaxial surface** with 1-4 (6) rows on each side of the elevated midrib; **buds** globose, 1-4 mm in diameter, those of the spurs reduced, the lower portion concealed by the persistent bud scales of the previous year, dark red to dark brown; **bud scales** broadly obovate or suborbicular, concave, mostly 0.5-1.3 mm long, the apex broadly rounded, shiny, dark red or red-brown, entire or fimbriate, the basal 2-4 scales of the terminal bud of the first-year branchlet ovate, smaller, acuminate, carinate, the base of the abaxial surface swollen, light yellow-brown; **branchlets** dimorphic; **long shoots** borne irregularly, often pendulous, yellow to light brown, becoming gray, dark gray or black, roughened by small (0.2 mm long) persistent projections or leaf bases of the juvenile leaves and the persistent spur shoots; **spur shoots** growing 0.5-1.0 mm per year, the persistent, recurved, dry membranous, lacerate, usually blackened bud scales forming annual rings around the spur, normally at 0.5-1.0 mm intervals, the spurs persistent for as many as 7-16 years, becoming as long as 1 cm; **branches** slender and ascending in the upper crown, often very long, the lower branches often horizontal or pendulous, persistent to the ground in open conditions covering only about half the trunk in closed forest stands; **bark** thin, smooth on young trees, 1-2 cm thick on older trees, furrowed and flaking off in small plates; **crown** regular and conical in open conditions, irregular with age, the leading shoots pendulous; **trunk** 50-150 cm in diameter; **tree** 10-50 meters tall, smaller and shrubby in more northern climates; **root system** shallow, spreading.

KEY TO SPECIES

1. Female cones 2.0 cm long or less, glabrous; branchlets orange-brown to red-brown.....1. *L. laricina*
1. Female cones 2.5 cm long or more, puberulent; branchlets yellow or yellow-brown.....2. *L. decidua*



1. *Larix laricina* (Duroi) K. Koch

Common Names: larch, tamarack, hackmatack, eastern, black, red, Canadian or Alaskan larch, hackimack

Type Description: Duroi, Obs. Botanicae, p. 69, 1771

Synonyms: *L. americana* Michx., *Pinus laricina* Duroi

Origin: Native primarily to the taiga zone of North America

Habitats: Frequently in moist locations, in swamps, along lake shores and river banks, particularly in southern parts of its range, but also on well-drained hillsides and mountain peaks farther north. Often found at high elevations in New York State, but confined to cold swamps or sphagnum bogs and fens at middle and lower elevations

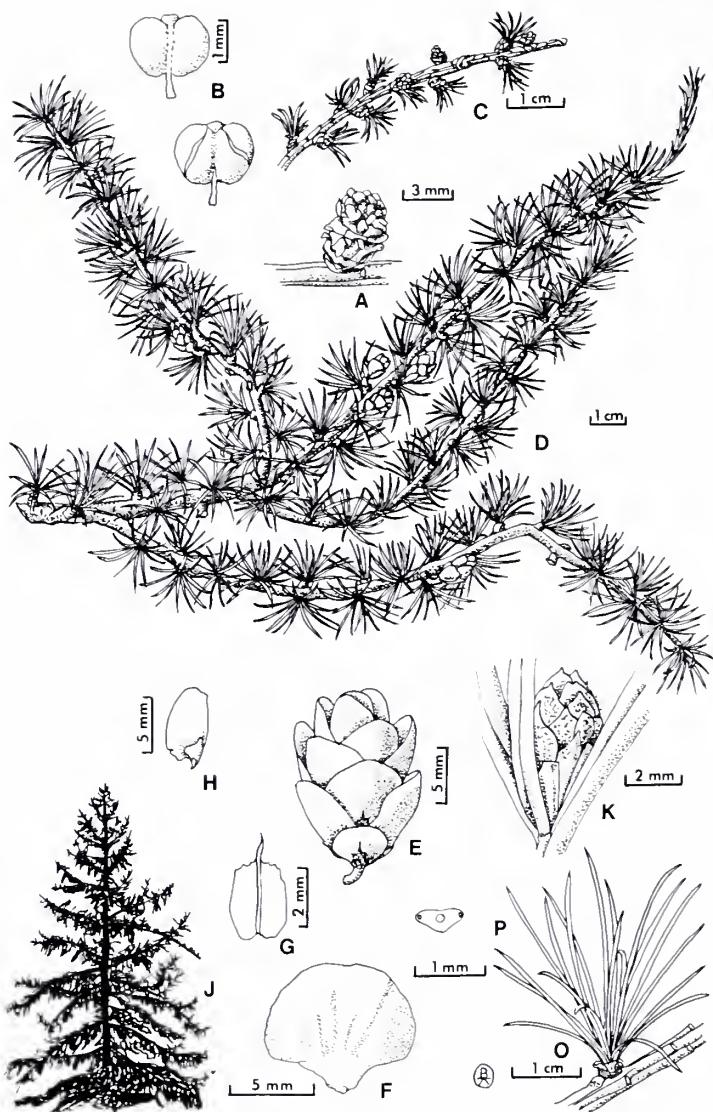
Habit: A small to medium-sized tree with a narrow, regularly conical crown in open conditions, and erect to pendulous leading shoot (in open conditions), often becoming contorted and broader with sweeping branches persistent to the base; commonly small and shrubby in more northern climates and dwarfed at treeline

Pollination: April-May

Mature Cones Opening: September-November of the 1st season

General Distribution: Newfoundland west to Alaska, south to northern New Jersey, northern Pennsylvania, northern Ohio, northern Indiana, northeastern Illinois, Wisconsin, eastern Minnesota, Manitoba, Saskatchewan and northern Alberta; disjunct in southwestern Pennsylvania, western Maryland, northern West Virginia and western Ohio

Description: monoecious; female cones globose or subglobose to oblong, 1.2-2.0 cm long, and nearly as wide; peduncle 4-5 mm long, scaly; bracts ovate to lance-ovate or oblong, about 4 mm long, 2.0-2.5 mm wide, light brown to yellow-green, glaucous when young, entire or sometimes erose, the awn about 1 mm long; female cone scales 9-12, not including 3-4 reduced scales at the base, or the greatly reduced, unopened scales at the apex, orbicular or nearly so, concave, thin, 7-9 mm in diameter, glabrous, the margins entire to minutely erose or denticulate, at least towards the apex; seeds obovoid, rounded at the apex, acute at the base 1.2-2.2 (2.5) mm long, 1.0-1.2 (1.5) mm wide, light brown, lacking resin, the wing obliquely ovate, apex obtuse or



acute, (2.5) 3.3-4.5 (5.0) mm long, (1-) 1.5-2.8 mm wide, pale brown; **male cones** globose, 3-4 mm in diameter; **sterile scales** about 24, ovate to flabellate, about 2 mm long, 1.5 mm wide, margins thin, rolled and often crumpled; **male cone scales** about 30, oblong, 1.0-1.5 mm long; **lamina** barely evident, (1-) 1.2-1.4 mm long; **microsporangia** opening longitudinally or obliquely, about 0.7 mm long; **juvenile leaves** with stomata usually in 1 or 2 longitudinal rows on each side of the midrib, or sometimes only at the apex, rarely lacking on the adaxial surface, with longitudinal bands of 3-6 rows of stomata on each side of elevated midrib on the slightly concave abaxial surface; **adult leaves** 25-35 per cluster on first- and second-year branchlets, 30-40 per cluster on older branchlets, often somewhat wider near the middle, (1.7) 2.2-2.7 (3.3) cm long, 0.8 mm wide, acute, light green, turning to a shining, brilliant yellow before falling after the 1st season, 1 row, and often an interrupted second longitudinal row, of stomata on each side of the slightly raised midrib, 2-3 rows per side at the extreme apex, **abaxial surface** with 2-3 stomatal rows on each side of the strongly elevated midrib; **buds** globose, 2-4 mm in diameter, those of the spurs reduced and the lower portion concealed by persistent bud scales of the previous year, dark red to dark brown; **bud scales** broadly obovate or suborbicular, concave, less than 1 mm long, the apex broadly rounded, shining, dark red or red-brown, entire or minutely ciliate; **long shoots** often pendulous, yellow-brown or light orange-brown the 1st year, becoming dull brown then gray, dark gray or black; **spurs** growing less than 0.5 mm per year, bud scales forming annual rings around the spur, normally at 0.5 mm intervals, spurs persisting for as many as 7-16 years, becoming as long as 1 cm; **branches** slender and ascending in the upper crown, very long, arching upward at the tips, horizontal or pendulous lower on the tree; **bark** smooth on young trees or on upper branches becoming appressed and thinly scaled, the small, rounded scales flaking off, light orange-brown becoming red-brown, shallowly furrowed, thin, 1-2 cm thick on older trunks; **crown** narrow, regularly conical in open conditions, often ice-damaged at the apex, becoming contorted and irregular with age, lower branchlet tips pendulous, brittle with age; **trunk** 50-65 (-100) cm in diameter; **tree** 10-20 (-35) m tall, smaller and shrubby in more northern climates, the branches persistent to ground level in open conditions, covering only about half the trunk in dense, forest stands; **root system** shallow, wide-spreading, moderately wind-firm ($2n = 24$).

Infraspecific Variation: *Larix laricina* is known to hybridize with *L. decidua* producing trees with cones that have 20-30 pubescent scales. This hybrid species, *L. × pendula* Salisbury, was named from trees in England in 1808, but is also known from northeastern United States, including New York. *Larix laricina* var. *incurva* Peck was named from trees in Sullivan County, New York.

Importance: The heavy, hard, very strong wood of larch is durable, somewhat coarse-grained and fire-resistant, making it an important source of telephone poles, railroad ties and fence posts. The wood has also been used in commercial shipbuilding and for turpentine extraction, and the bark has been a source of food and medicines. The roots were used by Native Americans as thread for sewing strips of birch bark to their canoe frames, while early pioneers used the roots for framing their canoes. Use of trees and shrubs of this species as ornamentals is limited, because of the large space required by healthy specimens with long, drooping lower branches. The ability of larch to grow in wet areas occasionally makes it useful for specific landscaping needs.



2. *Larix decidua* Miller

Common Name: European larch

Type Description: Miller, Gard. Dict., ed. 8, no. 1, 1768

Synonym: *L. europaea* DC.

Origin: Native to Europe and Siberia

Habitat: Open or closed woods, escaping rarely in cultivated stands and nearby areas

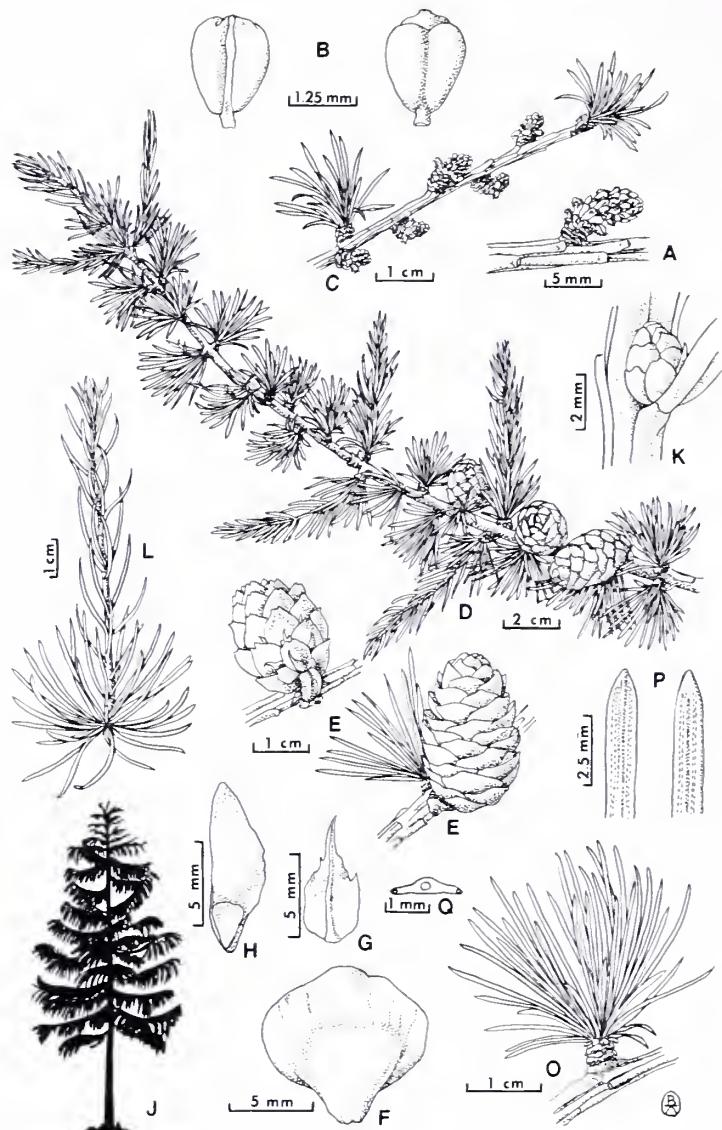
Habit: Tall tree with spreading branches, clear of branches in the lower half or the tree under forest conditions

Pollination: May

Mature Cones Opening: September of the 1st season

General Distribution: Europe east to Siberia; escaping cultivation in eastern North America including New York State

Description: monoecious; female cones 2.7-3.4 cm long, (1.7) 2.1-2.4 cm wide; peduncles (5) 6-8 (10) mm long; bracts oblong or lance-ovate, 7-9 mm long, 1.8-2.6 mm wide, the awn 2-3 mm long, decurrent at the base, dark red-brown at the base, lighter near the apex; female cone scales about 40-70, not including reduced scales at the base and apex, orbicular or orbicular-flabellate, thin, (8-) 10 (-13) mm in diameter, the apex sometimes slightly emarginate, puberulent on both surfaces, margins entire; seeds obovoid, about 4 mm long, 2 mm wide; wing sail-shaped, the apex obtuse, 5-7 mm long, about 4 mm wide, pale brown; male cones usually globose, sometimes slightly longer than wide, 4-6 mm in diameter; sterile scales 50 or more, ovate, 3-4 mm long, about 2 mm wide, the apex often tightly rolled back, the margins fimbriate; male cone scales 50-65, 1.6-2.0 mm long; lamina about 0.3 mm long, red-brown; microsporangia opening longitudinally, 1.2-1.4 mm long; juvenile leaves 1.8-2.3 cm long, more than 1 mm wide, the stomata in 1 or 2 longitudinal rows on each side of the midrib (toward the base), 2 (3) rows near the apex of the flat, adaxial surface, and (1) 2-3 (4) rows on each side of the slightly raised midrib on the abaxial surface; adult leaves usually 30-50 per cluster, 1.6-2.9 (3.3) cm long, 1.0-1.3 cm wide, bright green, becoming yellow before falling in the 1st season, adaxial surface flattened, with 1-2 longitudinal rows of stomata on each side of the midrib near the base, becoming 2-3 rows near the leaf apex, abaxial surface with 1-4 rows of stomata on each side of the elevated midrib; buds globose, 1-2 mm in diameter; bud scales nearly orbicular, concave, 0.5-1.3 mm in diameter, entire to slightly erose; branchlets (long shoots) often pendulous, glaucous the first year, yellow or light yellow-brown the first and second years, becoming yellow-brown or red-brown with gray stripes or furrows by the fourth year, later brown to black; spurs with annual rings about 0.8 mm thick, persisting up to 10 years or more; branches slender, stiff and ascending in the upper crown, long, horizontal, often pendulous lower on the tree; bark thin, 1-2 cm thick, smooth on young trees, fissured on older trunks, shedding as



small rounded plates, brown to dark gray; **crown** conical in both open and forested conditions, becoming irregular with age; **trunk** to 1.5 m in diameter; **tree** to 20 (-35) m tall, devoid of branches in the lower half in forest conditions; **root system** shallow ($2n = 24$).

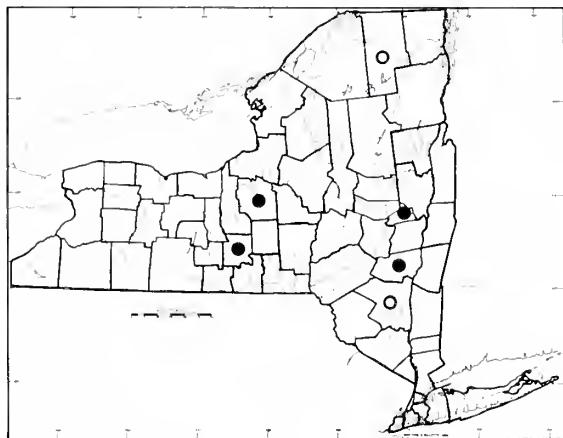
Importance: Once abundantly planted for reforestation purposes because of its rapid, straight growth capabilities and strong, durable wood, European larch is now only occasionally planted as an ornamental.

3. PSEUDOTSUGA

Common Names: Douglas-fir, Doug-fir, hangcone-fir

Authority: Carrière, Traité, Gén. Conif., ed. 2, p. 256, 1867

Pseudotsuga is a genus of about 5 species of western North America and eastern Asia. As many as 11 other species have been named, mostly in China and Mexico, but these are taxonomically questionable. *Pseudotsuga macrocarpa* (Vasey) Mayr is a southern Californian endemic. The Douglas-fir, *P. menziesii* (Mirb.) Franco, a native of the Rocky Mountains and other ranges in western North America, has the broadest distribution range. This species is immensely important for its timber and in the Christmas tree trade.



1. *Pseudotsuga menziesii* (Mirb.) Franco

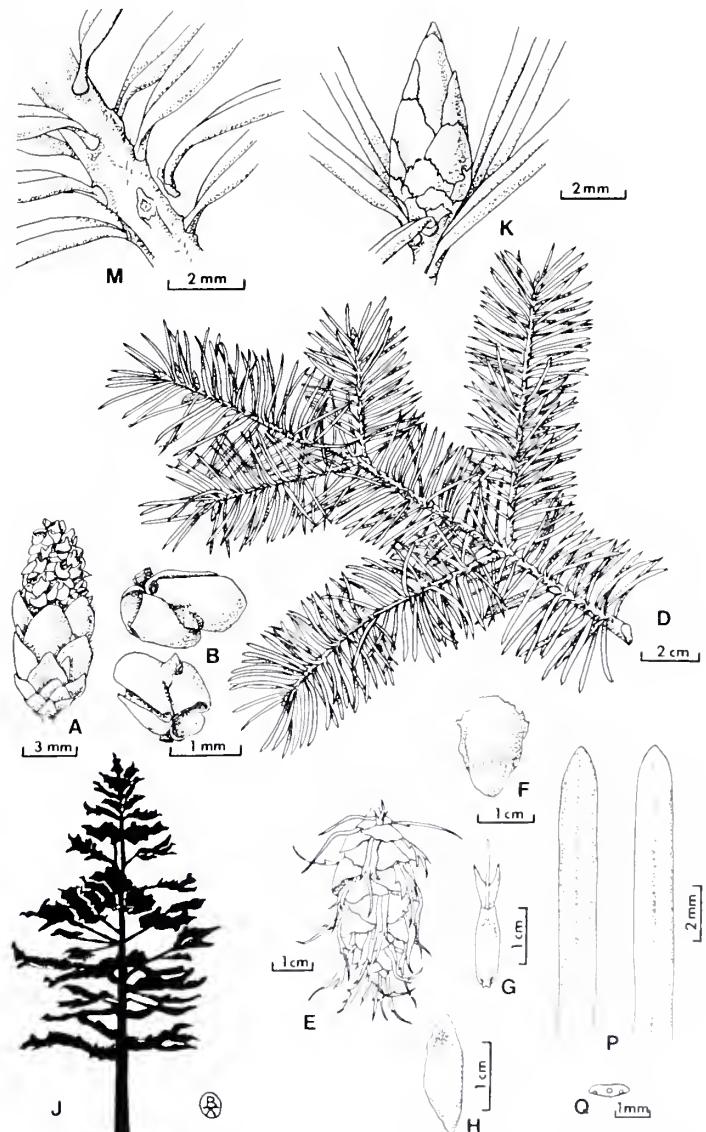
Common Names: Douglas-fir, Doug-fir, Oregon-pine, Douglas-spruce, Douglas-yew

Type Description: Mirbel, Mem. Mus. Hist. Nat., vol. 13, pp. 63, 70, 1825

Synonyms: *Abies menziesii* Mirb., *A. douglasii* Lindl., *Picea douglasii* Link, *Pinus douglasii* (Lindl.) Link, *P. taxifolia* Lambert, *Pseudotsuga douglasii* (Lindl.) Carrière, *P. lindleyana* Carrière, *P. taxifolia* (Lambert) Britt., *P. mucronata* Sudw.

Origin: Native to western North America

Habitats: In its native range, from sea level to about 3500 meters mostly in mixed conifer and mixed evergreen forests on deep, loamy well-drained soils, moist or drier exposed, rocky slopes, in the open or tolerating shade. Reproducing in New York State in a few instances where it establishes near plantations or large isolated trees



Habit: Large, straight-trunked tree with a conical, regular crown and horizontal branches

Pollination: April-June

Mature Cones Opening: September-October of the 1st season

General Distribution: The Rocky Mountains from southern Alberta north to central British Columbia, south to central California on the West Coast, and in the interior to New Mexico and west Texas, with outliers in Mexico as far south as Oaxaca. The tree occasionally escapes cultivation elsewhere, including New York State

Rarity: At this time, documented instances of naturalization after escape from cultivation in New York are rare. Inclusion of the species in this treatment as anything more than a waif is debatable; however, with increasing age of stands already planted in northeastern North America, and rising use in cultivation, successful reproduction, dispersal and establishment of this species should increase.

Description: monoecious; **female cones** pollinated, fertilized and maturing in the same year, borne scattered along the 2nd-year branchlets, erect or horizontal, rapidly becoming pendulous, oblong-cylindrical, somewhat narrowed at the apex, 5-8 (10) cm long, 2.7-3.3 cm wide, green when young, becoming brown, resinous, falling as a unit by spring of the following year; **peduncles** 7-11 mm long, initially erect or straight, soon curving down, covered with early-deciduous leaves; **bracts** exserted half their lengths, sometimes reflexed, obscurely spatulate to oblanceolate, 17-25 mm long, including the awn, 4-5 mm wide, papery, green when young, becoming brown, glabrous, upper margins irregularly serrate or erose, the apex bearing a central awn with a tooth on each side, the awn acute, 7-12 mm long, half as long as the exposed portion of the bract, the 2 sides cusps deltoid, 2.0-3.3 mm long, up to 2-3 mm wide, often weakly to strongly reflexed; **female cone scales** 35-40, orbicular or flabellate, conave, thin, 11-15 mm long, 13-22 mm wide, green with bright red apical margins, becoming brown, densely puberulent on the abaxial surface when young, slightly puberulent at the apex and on exposed parts of the adaxial surface; **male cones** borne laterally in loose clusters of 5-15 near the tips of the branchlets; cones oblong-cylindrical, 8-13 mm long, 2-3 mm wide, light orange-red or red-brown, often persistent into the next year; **peduncle** minute, completely concealed by sterile scales; **sterile scales** about 50, ovate-flabelliform, 2-5 mm long, 2-4 mm wide, the inner larger than the outer or basal ones, membranous, clear to light brown, glabrous, the inner scales ciliate-margined; **male cone scales** about 1.2 mm long, 1 mm wide, pale brown or yellow, glabrous; **lamina** barely evident, about 0.2 mm long; **microsporangia** dehiscing longitudinally, 0.7-0.9 mm long; **pollen** lacking wings; **leaves** solitary, spirally arranged, flattened, the bases twisted so that the leaves lie predominantly in one plane, leaves narrowed at the base, attached to a slightly swollen projection of the branchlet, part of the branchlet bark often pulling away on detachment, the leaf (1.7) 2.0-2.4 (3.0) cm long, 0.9-1.3 mm wide, bright green, sometimes blue-green, the narrowed base yellow-brown or yellow, glaucous when young, persistent, usually for 5-7 years or sometimes longer, **adaxial surface** lacking stomata, darker green, **abaxial surface** pale green, with 2 resin canals near the margins and 4-6 interrupted, longitudinal rows of stomata on each side of the elevated midrib; **buds** conical or cylindrical-conical, usually more than 2.5 times as long as wide, (5) 7-8 (9) mm long, 1.8-2.8 mm wide, acute, red-brown, glabrous, non-resinous; **bud scales** numerous, obovate or oblanceolate, 6-10 mm long, 4-5 mm wide, membranous, red-brown with hyaline margins, ciliate on the upper margins of the inner scales; **branchlets** horizontal, then pendulous, lustrous orange-brown the 1st year, bright red-brown the 2nd year, brown or gray thereafter, pubescent, becoming glabrous by the 4th year, older branchlets slightly roughened by the minute, swollen points of detachment of fallen leaves; **branches** horizontal, slender, often crowded; **bark** smooth, thin, often shiny, gray on young trees, becoming 20-30 cm thick and corky, with deep, rough furrows on older trees, orange-brown to dark brown; **crown** often narrow, conical to cylindrical; **trunk** straight, commonly reaching 1-2 (-3) meters in diameter (historically up to 5 meters), devoid of living branches in the lower 2/3 of the tree in crowded forest conditions; **trees** up to 70 (-90) meters tall; **root system** strong, well-developed laterally and wide-spreading ($2n = 24$).

Infraspecific Variation: Prominent among the characters that show variation are: leaf color and length, cone size, bark color, bract thickness and texture, and the degree of bract recurvature. Rocky Mountain populations are *P. menziesii* var. *glaucua* (Beissn.) Franco, differing from the typical west-coast variety in having blue-green, shorter leaves, smaller cones, strongly reflexed bracts, ascending branches and a slower-growing, more compact or dense growth habit. Several varieties have also been described from Mexico. Several cultivars have been propagated for ornamental use, including a few dwarf variants. Christmas tree growers select for blue or glaucous foliage and late spring new-growth, to avoid frost damage.

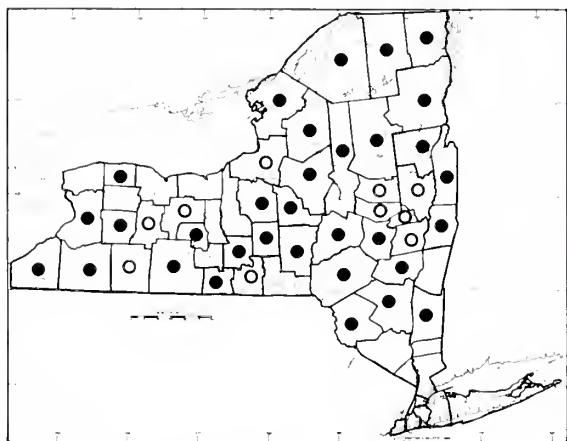
Importance: Douglas-fir is currently the most important lumber tree of North America. It is used mainly for construction purposes, prized for the huge girths attained by trunks that yield a largely knot-free wood. The wood is also strong, relatively light, straight-grained and durable. It does not warp or twist easily, and it holds nails well. This species is currently planted in western states on a large scale for timber, but also widely grown in eastern North America as a Christmas tree crop, as well as for ornament.

4. ABIES

Common Name: fir

Authority: Miller, Gard. Diet., abr. ed. 4, p. 16, 1754

Abies is a genus of about 40 species of tall, straight, symmetrically-branched forest trees of northern boreal and high altitude forests in the Northern Hemisphere. It is a taxonomically difficult genus, since firs appear to hybridize freely in cultivation, and several natural hybrids have been described from the wild. The genus is represented in eastern North America by 1-3 species, depending upon interpretation. Distinctive generic features of *Abies* are the erect female cones whose scales are deciduous, leaving naked cone axes on the branches, well-developed bracts inserted or exserted from between the scales, solitary leaves that are hypostomatic or amphistomatic, and whorls of branches at regular intervals on straight, tall and narrow, often spire-like trees. Logged for lumber and pulp, firs are also economically important as Christmas trees and for their resin. *Abies fraseri* (Pursh) Poir., Fraser fir, is a rare escape from cultivation in New York. A native of the southern Appalachians, it is closely related to our native *A. balsamea* (L.) Mill. It is distinguished from *A. balsamea* by exserted female cone bracts and more rows of stomata on the abaxial surfaces of the leaves. *Abies homolepis* Sieb. & Zucc. (native to Japan) and *A. magnifica* A. Murr., red fir (one of 12 species of western North America and five in the western United States), have escaped cultivation at single separate sites in New York State. *Abies magnifica* is easily distinguished from firs of eastern United States by its very large cones and gray or blue-gray, amphistomatic leaves. *Abies concolor* (Gord. & Glend.) Lindl. ex Hildeb., another western fir with blue-gray leaves is increasingly cultivated as a Christmas tree and ornamental in eastern North America.



1. *Abies balsamea* (L.) Miller

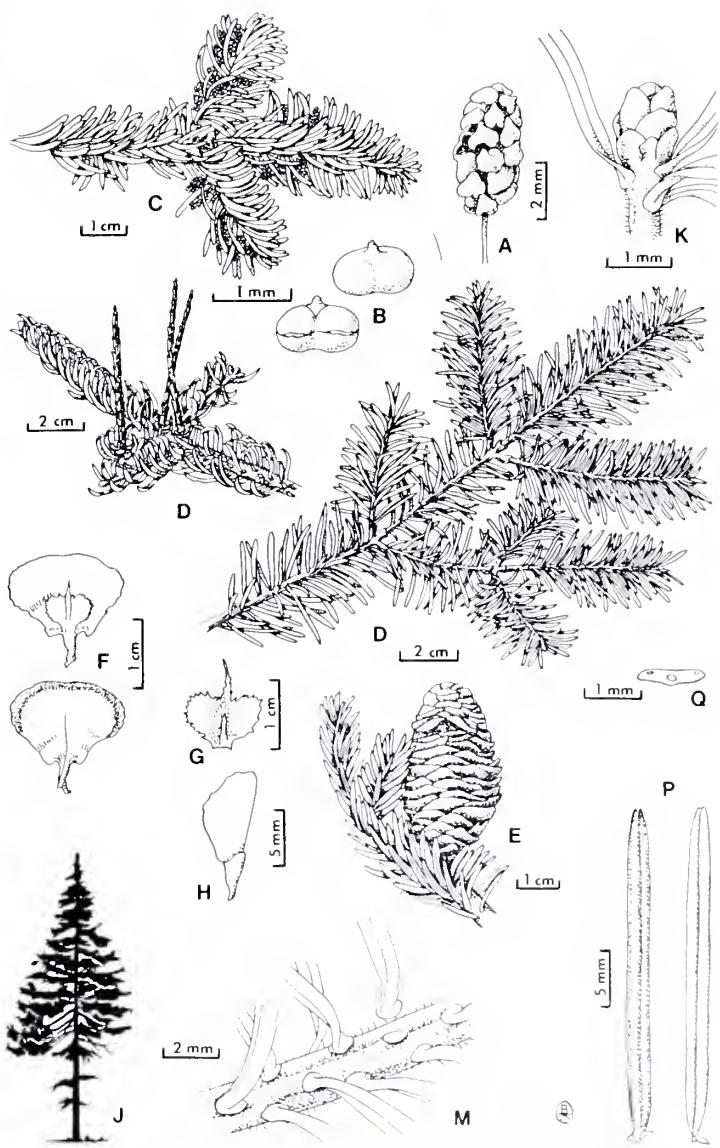
Common Names: balsam fir, balsam, fir-balsam, fir-pine, blister-pine, blisters, single-spruce, balm-of-Gilead, balm-of-Gilead fir, Canada balsam, eastern fir

Type Description: Linnaeus, Species Pl. II, p. 1002, 1753

Synonym: *Pinus balsamea* L.

Origin: Native to northeastern North America

Habitats: Boreal and montane forest tree in New York State, at high elevations in poorly drained soils of low, swampy ground and at the edges of bogs in the Adirondack and Catskill Mountains, thriving in cold swamps and bog borders (rarely, on well-drained north-facing hillsides) at lower elevations and non-mountainous parts of the State. Usually associated with red and black spruce, tamarack, and hemlock, in natural stands, also escaping cultiva-



tion in some wet or boggy areas and on moist northern hillsides

Habit: Medium-sized tree with a slender, symmetrical crown, becoming broader with age, or dwarfed at high elevations approaching timberline

Pollination: May-June

Mature Cones Opening: August-September of the 1st season, seed dispersal: September-November

General Distribution: Newfoundland west to north-central Alberta, south to northeastern Connecticut, northern Pennsylvania, northern Michigan, northern Wisconsin and northeastern Minnesota; disjunct in southwestern Wisconsin, northeastern Iowa, southeastern Minnesota and the Appalachian Mountains of Pennsylvania, West Virginia and Virginia

Description: **monoecious**; **female cones** solitary, borne on the upper (adaxial) surface of the branchlet of the previous year's growth, sessile, oblong-cylindrical, (3) 4-6 cm long, 2-3 cm wide, purple to dark purple or violet when young, becoming green or brown at maturity, usually covered or splotched with resin, scales deciduous the first year, leaving a slender, tapered, dark brown cone axis about 1 mm in diameter at the apex and 3 mm in diameter at the base, sometimes with a few small scales remaining at the base, frequently with a few undeveloped scales and seeds still attached at the apex; **bracts** longer than the scale and exserted when young, shorter than and enclosed by the subtending scale at maturity (remaining exserted in var. *phanerolepis*), flabellate-cuneate, spatulate or pandurate-spatulate, about 10 mm long, 5 mm wide, abruptly narrowed at the base and flattened against the cone scale above, pale brown, darker brown at base, the margins erose, midrib extending beyond the emarginate apex into a slender, acuminate awn 1-2 mm long; **female cone scales** deciduous, fan-shaped or flabellate, abruptly narrowed at the cuneate base, much shorter than the bract when young, usually longer than the bract when mature, about 1.5 cm long, 1.0-1.5 cm wide, purple when young, becoming brown with age, entire, the upper margins membranous, the exposed apex slightly upturned, often slightly erose, becoming pale green and pubescent; **seeds** wedge-shaped, 3-5 mm long, brown, lustrous, resinous, the **wing** wedge-shaped or obovate, obliquely cuneate at the base, about 9 mm long, 6 mm wide, light brown; **cotyledons** mostly 4 (5); **male cones** crowded in axils of leaves, principally along the sides and abaxial surface of the previous year's branchlets, pendulous, oblong-cylindrical, 6-10 mm long, 1.5-3.0 mm wide, yellow, deeply tinged red-purple; **sterile scales** 14-20, ovate, dark brown, scarious, the upper few falling with the cone, the remainder hardening and remaining on the branchlet for many years; **peduncles** 2-3 mm long, naked, partially concealed by the sterile scales at the base; **male cone scales** 50-70, spirally arranged, cordate, appearing peltate after opening of the microsporangia, about 1 mm long; **lamina** merely a minute mucro or beak at the apex of the stalk between the sporangia, about 0.1 mm long; **microsporangia** nearly as long as the stalk, opening by a transverse slit near the middle; **pollen** with two bladders (wings); **leaves** all similar on the same branchlet but consistently different on fertile or upper branchlets, spirally arranged, sessile, linear, entire, revolute, the base slightly broadened into a disk that leaves a circular scar when detached, aromatic, with a longitudinal resin canal on each side between the midrib and margin, persisting 5-7 (-10) years; **leaves (on upper and fertile branches)** directed forward and toward the upper side of the branchlet by a curving of the leaf bases, somewhat angular due to the thickened, elevated midrib on the adaxial surface, shorter than those on lower or sterile branchlets, stout, stiff, rigid, about 1 cm long, 1.5 mm wide, nearly one third as thick as wide, acute to acuminate or sometimes obtuse, often pungent, sharply curved upward at the apex, gray to gray-green, the stomata on the adaxial surface in longitudinal rows of 4-6 near the base to 8-10 near the apex, the abaxial surface with 8-10 rows of stomata on each side of the raised midrib; **leaves (on sterile branchlets)** spreading horizontally by twisting of the leaf bases, pectinate, flat, 1.5-2.5 cm long, about 2 mm wide, emarginate or obtuse, **adaxial surface** dark green, lustrous, usually with 1-2 (-3) short rows of stomata near the apex, the midrib a groove, **abaxial surface** pale green, with 2 longitudinal white or pale bands of stomata, each consisting of (4-) 6-8 (-10) rows of stomata, the stomatal bands losing their whiteness with age, the midrib slightly raised and separating the stomatal bands; **buds** ovoid to globose, obtuse, about 3 mm long, orange-green, very resinous; **bud scales** many, in 5-6 or more ranks, about 1 mm long, ovate or obovate, sometimes attenuate, red-brown to orange-green tinged with purple, lustrous, the margins membranous and short-fimbriate, the outer scales hardening and persisting for many years; **branchlets** opposite, rarely irregular, slender, 1-4 mm in diameter, light gray, gray-green or yellow-green the 1st year, becoming gray-brown, brown or blackened, smooth, the circular leaf scars not raised, pubescent, the short gray hairs becoming blackened through the accumulation of dust particles and fewer in number with age; **branches** usually (4) 5 (-7) in regular whorls, the lower branches dying and soon falling in closed forest conditions; **bark** of young trees smooth, thin, tight, gray with prominently raised areas or blisters containing resin, becoming 1.5 (-3.0) cm thick on older trees, separating into small irregular flakes, red-brown, gray-brown or dark gray; **crown** conical, symmetrical, slender, becoming broader when old, irregular, dwarfed or flagging under climatic stress near treeline; **trunk** to 50 (-100) cm in diameter, **tree** short-lived (often less than 100 years), 10-29 m tall, only 1-2 m tall at high elevations approaching timberline; **root system** shallow to moderately deep, depending on soils, wide-spreading ($2n = 24$).

Infraspecific Variation: *Abies balsamea* var. *phanerolepis* Fern. is apparently found in a few locations scattered through nearly the entire eastern range of balsam fir. Trees corresponding to this taxon have sometimes been considered natural hybrids of *A. balsamea*

and *A. fraseri* of the southern Appalachians. Current indications are that var. *phanerolepis* differentiated in isolation since the Pleistocene, rather than resulting from hybridization during post-Pleistocene range expansions from separate refugia (Jacobs *et al.*, 1984; Zavarin & Snajberk, 1972). The most distinctive feature of var. *phanerolepis* is presence of slightly-reflexed, exserted bracts in the mature cone, while its other characteristics fit within the range of variation of typical *A. balsamea*. Cones of var. *phanerolepis* are also generally on the shorter end of the range of variation for var. *balsamea*. The bracts may be barely visible or long-protruding as in *A. fraseri* and slightly reflexed. Characters, such as a greater number of stomatal rows on the leaves and redder hairs on the twigs of *A. fraseri* are variable, and do not adequately distinguish the two species. The adaxial surfaces of leaves of *A. balsamea* may have no stomata, stomata that occur only near the tips, or a row or two extending nearly half the length of the leaf. *Abies balsamea* f. *hudsonia* (Bosc ex Jacques) Fern. & Weath. was named on the basis of the prostrate habit and shorter, broader leaves of plants that are found at treeline or other harsh, wind-swept high-elevation sites.

KEY TO VARIETIES

1. Bracts of the female cone not exserted beyond the scales 1a. *A. balsamea* var. *balsamea*
1. Bracts of the female cone exserted 1b. *A. balsamea* var. *phanerolepis*

1a. *Abies balsamea* var. *balsamea*

Common Name: balsam fir

Habitats: Primarily high elevations in the Adirondack and Catskill Mountains, swampy areas and edges of bogs; rarely on well-drained north-facing slopes at lower elevations

Habit: Tree with symmetrical crown, except near timberline when the Krummholz (low shrubby, sometimes prostrate) form is evident

1b. *Abies balsamea* var. *phanerolepis* Fern.

Common Names: bracted balsam fir, hybrid fir, Canaan fir, bracted fir

Habitats: As in *A. balsamea* var. *balsamea*, but occurring only very rarely in New York and the Northeast

Habit: A tall tree with a symmetrical crown

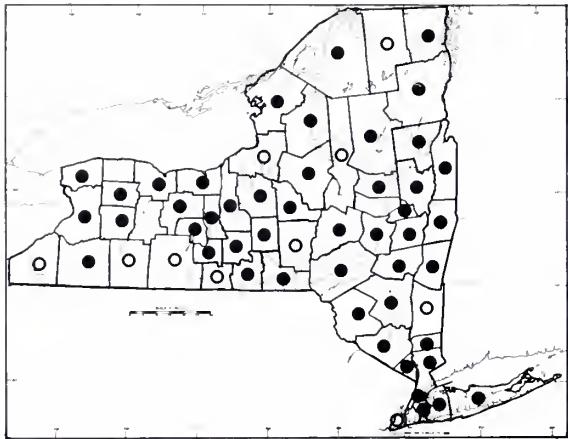
Importance: Balsam oil gathered from "blisters" on tree trunks has been a valuable medicinal remedy for a great variety of ailments by Native American and early European settlers. A turpentine is made from the oil that still is sometimes used in varnish manufacture and as a fixative for microscopic specimens. The lumber, which is light, soft, weak, coarse-grained and perishable, is used mostly for pulp and building packing-crates. The leaves have long been harvested and made into aromatic "balsam pillows," currently marketed to tourists in souvenir shops of the Northeast. The most important use of balsam fir is as a premium Christmas tree, noted for its aromatic, dark green, persistent and soft-tipped leaves and the natural, conical shape of the crown. Large quantities of seeds are collected and seedlings purchased each year for Christmas tree plantations. This fir is of little use as an ornamental except for a few cultivars that have propagated from side-branch cuttings. These are marketed as dwarf conifers, although many do not remain dwarfs without pruning.

5. TSUGA

Common Names: hemlock, hemlock-spruce

Authority: Carrière, Traité Gen. Conif., p. 185, 1855

A genus of 10 species native to north-temperate North America and Asia. *Tsuga heterophylla* (Raf.) Sarg. and *T. mertensiana* (Bong.) Carrière, are native to northwestern North America, *Tsuga caroliniana* Engelm. is native to the southeastern U. S., and *T. canadensis* (L.) Carrière the northeastern native species. Hemlocks are easily recognized by their graceful habit with pendulous leading shoots, short linear leaves of different sizes on the same branchlet, and small pendulous cones with small bracts concealed between the scales. *Tsuga* species are variable, showing some obvious links in growth habit, leaf, branchlet, pollen and female cone morphology to certain other genera of Pinaceae. Using these characters, Page (1989, 1990) recognized two genera: *Nothotsuga* H.H. Hu ex C.N. Page, and *Hesperopeuce* (Engelm.) Lemmon. Similar features shared by *Picea* species and *Tsuga mertensiana* were used to justify recognition of the intermediate, monotypic genus, *Hesperopeuce*, and prompted GausSEN (1966) to postulate recent hybridization between *Tsuga* and *Picea*. *Tsuga* also shows some similarities to the Chinese genus *Cathaya*. The New York native hemlock, *T. canadensis*, has easily proved the most economically important species of the genus, both in the past, when its bark was so desirable for the tanning industry, and presently, as the source of over 250 cultivated varieties.



1. *Tsuga canadensis* (L.) Carrière

Common Names: eastern hemlock, spruce-pine, hemlock-spruce, Canada or Canadian hemlock, hemlock-pine, white hemlock, Wisconsin hemlock-pine, hemlock-fir, red hemlock, tanbark tree, water-spruce, weeping-spruce

Type Description: Linnaeus, Species Pl., ed. 2, p. 1421, 1763

Synonyms: *Abies canadensis* (L.) Michx., *Pinus canadensis* L., *T. americana* Farw.

Origin: Native to northeastern North America

Habitats: Common in dense, shady, often moist forests. Also commonly scattered in open rocky woodlands at edges of bogs and in upland forests, often filling ravines or covering north-facing slopes of rocky ridges, the banks of rivers and streams and even vertical, rocky banks of narrow river gorges. Widely distributed throughout the State

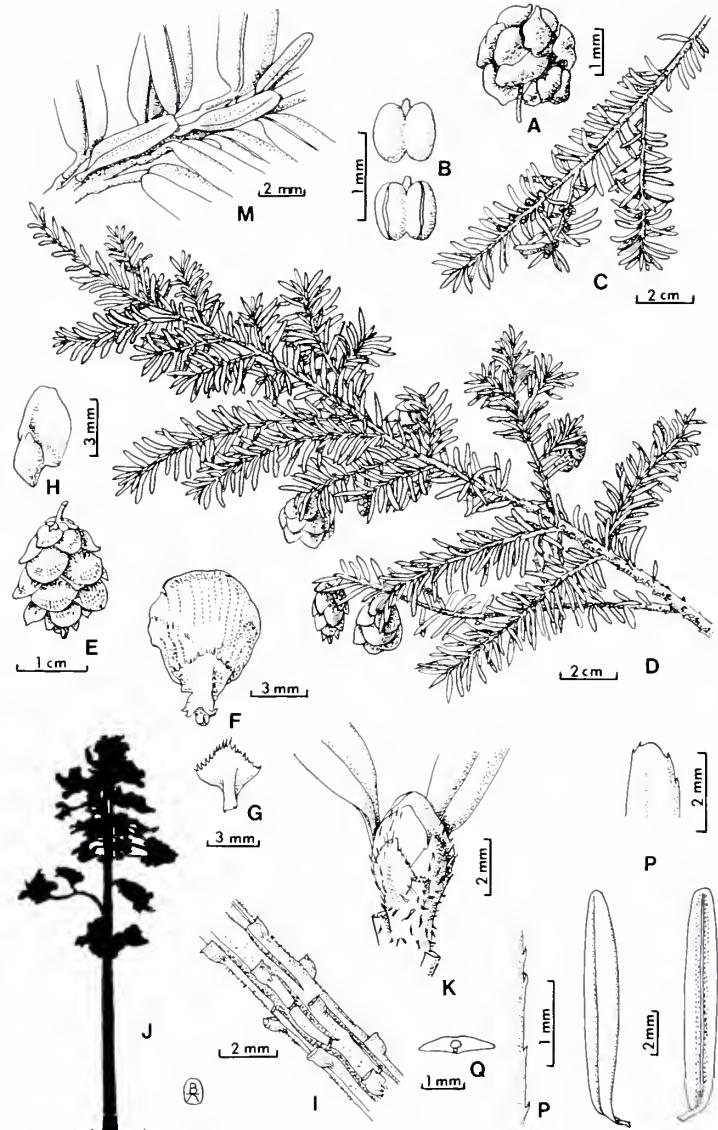
Habit: Medium-sized to large tree, with long, slender branches often drooping, forming a broadly conical crown with a pendulous, flexible apex and a strongly tapering trunk that is often devoid of living branches in its lower two-thirds

Pollination: April-June

Mature Cones Opening: September-October of the 1st season

General Distribution: Nova Scotia west to northern Michigan and Wisconsin, south through New Jersey and western Maryland to northern Georgia and Alabama; disjunct in central eastern Minnesota, southern Indiana and central North Carolina

Description: **monoecious;** **female cones** terminal, oblong-cylindrical, 5-8 mm long at pollination, becoming 1.3-2.0 cm long, 1.2-1.8 cm wide, erect and purple to pink-tinged green prior to pollination, turning down with the scales becoming tightly appressed and bright green soon after pollination, finally pendulous, open and brown, persistent only through the first winter with gradual dispersal of the seeds; **peduncle** 1.0-2.5 mm long, pubescent; **bracts** flabellate, about 1.5 mm long and broad, 1/3 to 1/2 the length of the young scale, 1/4 to 1/6 the length of the mature scale, brown to purple-brown, membranous and coarsely laciniate or fimbriate at the broad apex and upper margins, lower margins entire; **female cone scales** obovate to nearly orbicular, concave, 4-6 times as long as the inconspicuous bracts, 4-5 mm long at pollination, 7-10 mm long at maturity, smaller toward the cone apex and base, entire, glabrous, persistent, dark purple, becoming brown, the exposed, slightly-thickened apex of the lower surface light brown to green; **seeds** ovoid-oblong, slightly compressed, nearly half as long as their wings, 2-3 mm



long, 1.5-2.0 mm wide, broad at the base and gradually tapering to the rounded apex, light brown, with 2-3 resin vesicles, **wing** obovate-oblong, sail-shaped, rounded or obtuse at the apex, attaching obliquely to the seed, 5-6 mm long, about 3 mm wide, pale brown; **cotyledons** 3-6; **male cones** terminal or axillary, crowded or solitary on branchlets of the year, 2.0-2.5 mm in diameter prior to pollination, becoming 4-6 (-9) mm long, about 2 mm wide, light yellow-brown to brown; **sterile scales** 15-20; **peduncle** fragile, slender, naked, about 2.5 mm long, loosely covered at the base by persistent, sterile bud scales; **male cone scales** 10, spirally arranged, but with the appearance of a globose cluster, 1.0-1.5 mm long; **lamina** broadly acute, thickened, appearing as a bump or mucro projecting laterally from the apex of the male cone scale, about 0.1 mm long; **microsporangia** 0.8-1.3 mm long, opening by a longitudinal slit; **pollen** with circular ridge and sculpturing, not winged; **leaves** all similar, but of different sizes and orientations on the same branchlet, spirally arranged, the petioles twisted so that the leaves project upwards or laterally away from the branchlet, often with the 4th leaf of each of 2 spiral series shorter and directed forward along (or parallel to) the upper surface of the branchlet (thus the appearance from the top of the branchlet is that every 8th leaf is flattened against the upper surface) the leaves between the upper parallel blades and the lower horizontal ones of intermediate sizes, blades linear, flat, 3-12 (-18) mm long, 1.0-1.5 mm wide, apex rounded to obtusely pointed (rarely emarginate or notched), green, sometimes yellow-green, sometimes lustrous on the adaxial surface, aromatic when crushed, margins slightly revolute, entire becoming sparsely denticulate toward the apex, persistent several years, resin canal 1, **adaxial surface** grooved at the midrib, lacking stomata, **abaxial surface** with 2 white stomatal bands each consisting of 6 broken rows on each side of the raised pale white midrib and separated from it by a thin band of green that is less than or equal in width to the green margins; **buds** ovoid, acute, 3-5 mm long, light chestnut-brown to red-brown, puberulous; **petioles** usually flattened against the branchlet, 0.5-0.8 mm wide, twisted, white or pale yellow; **bud scales** ovate, thin or membranous near the upper margins, pubescence decreasing with age, persistent; **petioles** often twisted, usually flattened against the branchlet, 0.5-0.8 mm long, 0.3-0.4 mm wide, white or pale yellow; **branchlets** pubescent, becoming less so with age, rough, thinly grooved, the grooves formed by pulvini or raised decurrent projections of the twig where the leaf is attached, pale brown becoming gray, pubescent but becoming sparsely so with age; **branches** long, slender, slightly ascending to horizontal, then flexible and pendulous at the very tip, especially during the season of maximum growth, irregularly and pinnately ramified, borne irregularly on the trunk, the lower 2/3 of which is often bare, or branches may be persistent to the base, even under forest conditions; **bark** 1.5-7.5 cm thick, deeply fissured into narrow rounded plates and ridges covered with close scales, red-brown to gray tinged with purple or gray-brown, cinnamon-red (and astringent) below the surface; **crown** broadly conical becoming slightly irregular with age, the long, slender branches often pendulous, the apex pendulous and flexible during much of the year, but stiffening over winter; **trunk** to 1 meter (-2.2 m) in diameter, strongly tapered, often somewhat buttressed at base; **tree** 20-30 m tall; **root system** broadly spreading, the major lateral roots sometimes exposed above ground level ($2n = 24$).

Infraspecific Variation: *Tsuga canadensis* harbors considerable genetic diversity, as has been demonstrated by the many cultivars that breeding has yielded. Variable growth rates, in addition to density, length and color of the leaves, define cultivated varieties in a group that, on the whole, expresses little variation in the wild.

Importance: The bark of hemlock is a rich source of tannin that was exploited to a high degree in the 19th and early 20th centuries. The wood is weak, brittle, coarse-grained, difficult to work and not durable, therefore, not valuable for quality lumber. Instead, its light weight has prompted its use for boxes and crates, railroad ties, and, to some extent, log houses, although the rapid taper of the bole limits this application. The wood has also been used for pulp. Oil of hemlock, distilled from the young branches was once an important product, used mostly as a veterinary liniment. Native Americans and early colonists extracted the bark for teas, beers, dyes and a great variety of medicines. The principal economically important use of the plant today is as an ornamental. The tree is planted for shade, but most of the horticultural interest is in its plethora of varieties. Vegetative variation within the species has offered abundant opportunity for development of over 250 cultivars, propagated mainly by rooted cuttings and grafts. Dwarf cultivars are of particular interest, and the more desirable of these often command a high price.

6. PICEA

Common Name: spruce

Authority: A. Dietrich, Fl. Geg. Berlin, p. 794, 1824

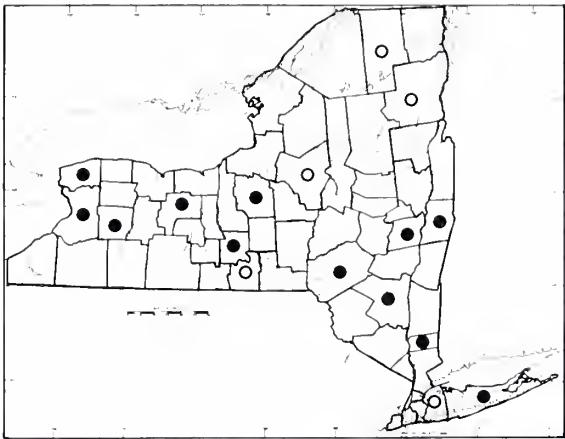
Picea is genus of about 35 species of trees, widely distributed, mostly at high altitudes, in the Northern Hemisphere. Eight species are native to North America, five in the west, two in the east, and *P. glauca* (Moench) Voss spans the northern part of the continent. Research on the systematics of the genus indicates weak genetic barriers among species with the presence of natural hybrids (Bobrov, 1972). It has been postulated that the most important prerequisites for speciation in the genus, then, would be geographic isolation and variation in phenology (Wright, 1955). This premise has not been challenged by investigations of characters such as seed-scale morphology, pollen grain size, leaf anatomy and morphology, endosperm isoenzymes and other chem-

ical characters (Alden, 1987; Schantz and Juvonen, 1966; Wellendorf and Kaufmann, 1977; Wellendorf and Simonsen, 1979). Earlier classification schemes placed spruce species in three sections: *Picea*, *Omorika* Willk. and *Casicta* Mayr, mostly based on flatness of the leaves, amphistomatic vs. hypostomatic leaves and thickness of female cone scales. Most researchers have abandoned this classification, although Alden (1987) retained placement of the species in two sections, *Picea* and *Castica*, while admitting that their use has limited application. Schmidt (1989) also found spruce female cone morphology of use in supporting division of the genus into two subgenera or sections. Spruces are economically important for lumber, pulp and landscape plantings, and they are extensively cultivated. *Picea glauca* is planted in large numbers in Christmas tree plantations in northeastern North America, particularly in New York State. European *P. abies* Karst., Norway spruce, is ubiquitous as a planted tree of old lawns, parks, cemeteries and streets in eastern North America, as well as escaping from plantations into the wild. *Picea pungens* Engelm., the blue spruce of the Rocky Mountains, is also cultivated extensively as a lawn tree and prized for its bluish foliage and dense, symmetrical growth. It is reported as a rare escape in New York State. *Picea glauca* is the only native northeastern species popular in cultivation, but exotic species such as *P. omorika* (Pancic) Purkyne, Serbian spruce, are planted to a considerable extent. Over 350 cultivars of *Picea* have been developed for the nursery trade.

Description: monocious; **female cones** pollinated in spring of the first year after initiation, fertilized and maturing during the same year, terminal, subterminal or scattered along branchlets of the year, sessile, erect, globose, subglobose or ovoid, and green or purple when young, becoming oblong-cylindric, pendulous, peduncled, brown or red-brown; **peduncles** 1-4 mm long, thick, covered with sterile cone scales, soon twisting so that the cone becomes pendulous; **bracts** reduced, concealed, oblong or spatulate to orbicular, 1-4 mm long, 1.0-2.5 mm wide, quickly surpassed by the cone scales, the apex toothed, midrib projecting as a mucro or short subulate awn, brown to dark brown; **female cone scales** many, thin, oblong, the apex usually erose or sometimes notched, the exposed abaxial apex lighter brown or yellow-brown and often thicker, a few scales at the apex and the base usually reduced and remaining closed; **ovules** acute or divided at the apex (micropylar end), projecting just beyond the margin at the very base of the subtending scale; **seeds** rhombic, obovate or ovate, rounded on the sides, gradually narrowed to an obliquely acute or obtuse base, lacking resin, **wing** membranous, obliquely obovate or wedge-shaped, obliquely attached to the seed, pale brown; **cotyledons** 4-15; **male cones** solitary, oblong-cylindrical, borne at the tips or scattered laterally along the branchlets; **sterile scales** 25-35 in four series, similar to branchlet bud scales, scarious, the outer ones hardened and broadly keeled, the inner longer and more transparent; **peduncles** up to 2 cm long, usually concealed by the sterile bud scales; **male cone scales** numerous, oblong, usually 1-3 mm long, yellow-brown to red-brown, glabrous; **lamina** 0.5-1.5 mm long, 0.5-2.0 mm wide, **microsporangia** opening longitudinally; **pollen** winged; **leaves** solitary, spirally arranged, radiating in all directions from the branchlet, or those on the adaxial branchlet surface directed upwards (particularly true of fertile branchlets and those toward the apex of the tree), borne on decurrent woody pegs or sterigmata that project 0.5-1.0 mm from the branchlet and detach with the leaf when green, but remain when leaf is left to turn brown and fall, 4-angled, therefore with 2 adaxial and 2 abaxial surfaces (those of some species outside New York more bifacially flattened, with essentially 2 surfaces), sometimes extremely bilaterally flattened, so that the leaf cross-section is 3 or more times deeper than wide, 6-20 mm long (in ours), 0.5-2.0 mm wide (in ours) acute, often pungent, resin canals 1-2, leaves amphistomatic (in ours) or stomata on upper surface only in some species, occasionally hyperstomatic, persistent for 7-30 years; **buds** ovoid, red-brown; **bud scales** many, mostly persistent, imbricate, appressed, ovate, acuminate, the tips of the outer scales spreading or reflexed, those at the base of the terminal bud often with midrib projecting as a subulate arista or awn 1-2 mm long (or as long or longer than the scale); **branchlets** orange to red-brown for 3 years, brown to dark brown thereafter, glabrous or pubescent, roughened by the persistent, decurrent, raised, hardened, woody leaf bases; **bark** very thin, scaly, red-brown to brown or gray; **crown** conical, symmetrical; **trunk** to 1 m or more in diameter, often devoid of branches on the lower half or with persistent dead branches; **trees** tall, straight, with irregular or regularly whorled branches; **root system** usually spreading, shallow to moderately deep.

KEY TO SPECIES

1. Female cones 9-18 cm long; trees with long sweeping branches; lateral branchlets pendulous, glabrous.....1. *P. abies*
1. Female cones 1-5 cm long; branches short, horizontal or ascending; lateral branchlets horizontal, pubescent or glabrous(2)
 2. Branchlets glabrous; buds glabrous; basal bud scales obtuse, acute or short-acuminate; mature female cones 4-5 cm long2. *P. glauca*
 2. Branchlets pubescent, usually glandular-pubescent; buds pubescent; basal bud scales long-acuminate or aristate; mature female cones mostly 4 cm long or less.....(3)
3. Leaves mostly 6-12 mm long, initially glaucous, straight; female cones usually persistent for several years, mostly 2-2.5 cm long, the scales strongly erose3. *P. mariana*
3. Leaves mostly 12-15 mm long, not glaucous, curved; female cones deciduous in the first or second year, mostly 3-4 cm long, the scales entire or slightly erose4. *P. rubens*



1. *Picea abies* (L.) Karsten

Common Name: Norway spruce

Type Description: Linnaeus, Species Pl. II, p. 1002, 1753

Synonyms: *Picea rubra* A. Dietr., *non* Link, *P. excelsa* Link, *Pinus abies* L., *Pinus picea* Duroi

Origin: Native to northern Europe

Habitat: Escaped from cultivation in woods, shaded places, borders and old fields, the seedlings sometimes establishing in profusion in clearings near forest plantings

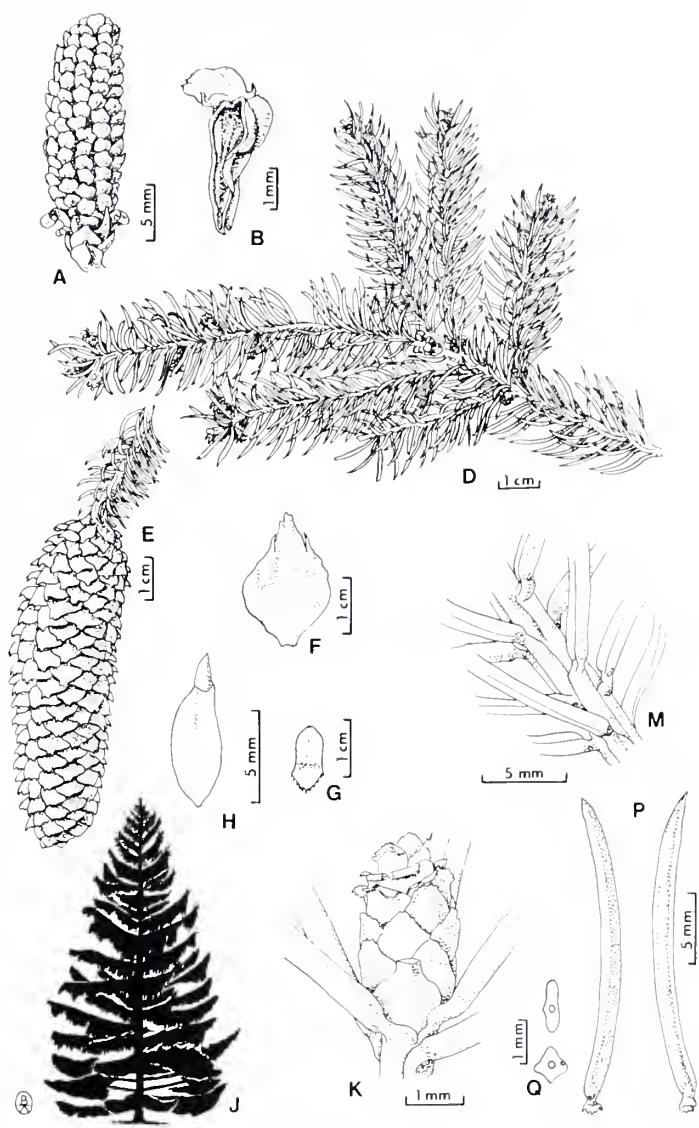
Habit: Medium to large tree with a straight trunk and broadly conical crown, with long, sweeping branches that ascend at the tips, these persistent to the trunk base in open conditions, the lower 1/3-2/3 of the branches often dying, but remaining on the tree for years in forest stands and plantations, making them almost impenetrable

Pollination: April-June

Mature Cones Opening: August-September of the 1st season

General Distribution: Central and Northern Europe, cultivated extensively and naturalizing in eastern North America from scattered trees grown in open areas as well as plantations and reforestation projects

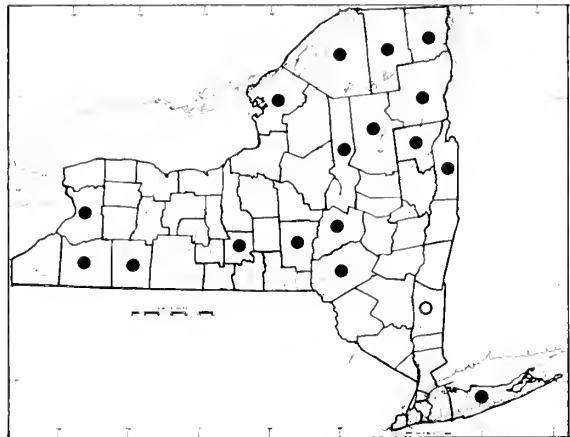
Description: **monoecious;** **female cones** terminal, cylindrical-oblong, 9-18 (-25) cm long, 4.3-5.0 (-6) cm wide, bright purple when young, becoming light brown, lustrous; **bracts** oblong, acute; **cone scales** obovate to oblong-obovate, 18-25 mm long, 15-20 mm wide, slightly concave, the apex tapered then truncate, crenulate to erose and often emarginate, the exposed portion thickened, apical margin thinner and tending to curl upward, light brown where exposed, darker brown where covered by the subtending scales; **seeds** obovate, wedge-shaped, the base acute, 3.0-4.5 mm long, 1.7-2.0 mm wide, light brown to dark brown or almost black, glabrous, **wing** obovate, wedge-shaped, 9-17 mm long, 5-7 mm wide, light brown, lustrous; **male cones** oblong-cylindrical, slightly tapering at the apex, 16-27 mm long, about 7 mm wide, light brown; **peduncle** 2-3 (4.5) mm long, usually partially hidden by persistent bud scales; **male cone scales** numerous (up to 200), oblong, about 3 mm long; **lamina** 0.9-1.5 mm long, about 2 mm wide, lacinate, light brown; **leaves** spirally arranged, often spreading horizontally to give the branchlet a flattened appearance, the persistent bases or sterigmata of the lower branchlet surface twisted, the leaves curved, projecting upward from the branchlet, therefore those on the sides and lower branchlet surface each having 1 adaxial and 1 abaxial surface facing upward, usually more flattened bilaterally than bifacially, therefore, often thicker than wide, 12-20 mm long, 1.0-1.5 mm wide, abruptly acute, often hard and sharp at the tip, green, persistent at least 7 years, stomata arranged in (3) 4-5 (-



7) rows on the two **adaxial** surfaces and 3-5 (6) rows on the 2 **abaxial** surfaces, usually increasing in number toward the apex, the midrib or angle usually equally and strongly elevated on both surfaces; **buds** ovoid to conical, (2-) 4-8 (-10) mm long, the apex often with ragged appearance from the early spreading of the scale apices, red-brown to light brown, barely resinous; **bud scales** many and variable, broadly ovate, concave, 2-3 mm long, upper margins and apex ciliate, sometimes shortly keeled at the acute apex, red-brown to brown, glabrous to minutely puberulent near the apex, the outer or basal scales of the terminal bud often with a subulate or awn-like extension at the apex, the awn 0.5 (-1) mm long and often surpassing the apex of the bud; **branchlets** horizontal, usually becoming pendulous, light brown to orange-brown in the 1st 2 years, becoming brown or gray-brown, usually sparsely and minutely puberulent or rarely densely glandular-pubescent the 1st year, glabrous or occasionally pubescent thereafter, the grooves or exposed parts of the branchlets between the decurrent sterigmata broad; **branches** long (to 6 m in open conditions), stout, pendulous, ascending and turning upward to nearly erect at the tips, the numerous lateral branchlets pendulous; **bark** thin, less than 1 cm thick on older trees, tight, slightly roughened or smooth, red-brown, becoming light gray, developing small scales or flakes that gradually fall off larger and older trunks; **trunk** to 75 cm or more in diameter, with branches persistent to the ground in open conditions, the bottom branches with the ability to layer, in forest stands the lower 1/3-2/3 of the branches remaining on the tree for many years; **crown** usually broadly conical, occasionally narrowly conical; **tree** to 40 (-50) m tall; **root system** spreading, shallow to moderately deep ($2n = 24$).

Infraspecific Variation: A very large number of horticultural varieties of *P. abies* are established in the cultivated flora of the world, and many of these are grown in New York. Variation throughout the natural range of Norway spruce is extensive, with several botanical varieties and forms having been described in Europe. Branchlet vestiture (absence, presence, density and glandularity), leaf characters (orientation on the branchlet, shape, color, arrangement of stomata and resin canals), cone and cone scale characters (size and shape) all show a wide range of variation in the wild in Europe (Lindquist, 1948), and variation is less, but evident in North American trees as well. Branches are typically long and sweeping, but they can be more erect, shorter and stiffer, with branchlets less pendulous. This variation combined with more angular leaves that do not spread horizontally along the branchlets can make this spruce look similar to *P. glauca*. *Picea abies* var. *obovata* (Ledeb.) Hultén is a widely recognized variety cultivated to a limited extent in this country, and it may have escaped. These trees have densely pubescent twigs and shorter female cones, and the leaves and obovate female cone scales have rounded apices.

Importance: Historically, this species was an important lumber and pulp producer in Europe, used for ship-building and a variety of other purposes. Norway spruce has been a tree of significant economic value in North America as well. Introduced early to this country, it has been planted extensively for ornament, windbreaks, as a street tree and in cemetaries. It continues to be planted for reforestation purposes as well. Rapid loss of leaves after cutting severely limits its use as a Christmas tree. The tree is beginning to be harvested for pulp and construction, and rarely for log houses.



2. *Picea glauca* (Moench) Voss

Common Names: white spruce, cat spruce, Canadian or Canada spruce, skunk spruce, single spruce

Type Description: Moench, Verzeich. ausl. Baum. und Stand., p. 73, 1785

Synonyms: *Abies alba* Michx., *A. canadensis* Mill., *Picea alba* (Michx.) Link, *P. canadensis* (Mill.) BSP., *P. laxa* Sargent, *Pinus glauca* Moench, *P. alba* Ait.

Origin: Native to northern North America

Habitats: New York State, in vernally moist areas flanking the northern Adirondacks, from limestone, alvar associations to more acidic flatrock communities, seeps and slopes to middle elevations, also escaping cultivation in other parts of the State. Northward in its range, in low, moist, alluvial soils, often along stream banks, shores of lakes and ponds, on moist hillsides and the borders of swamps, woods and open areas, high elevations to boreal salt-sprayed sea cliffs

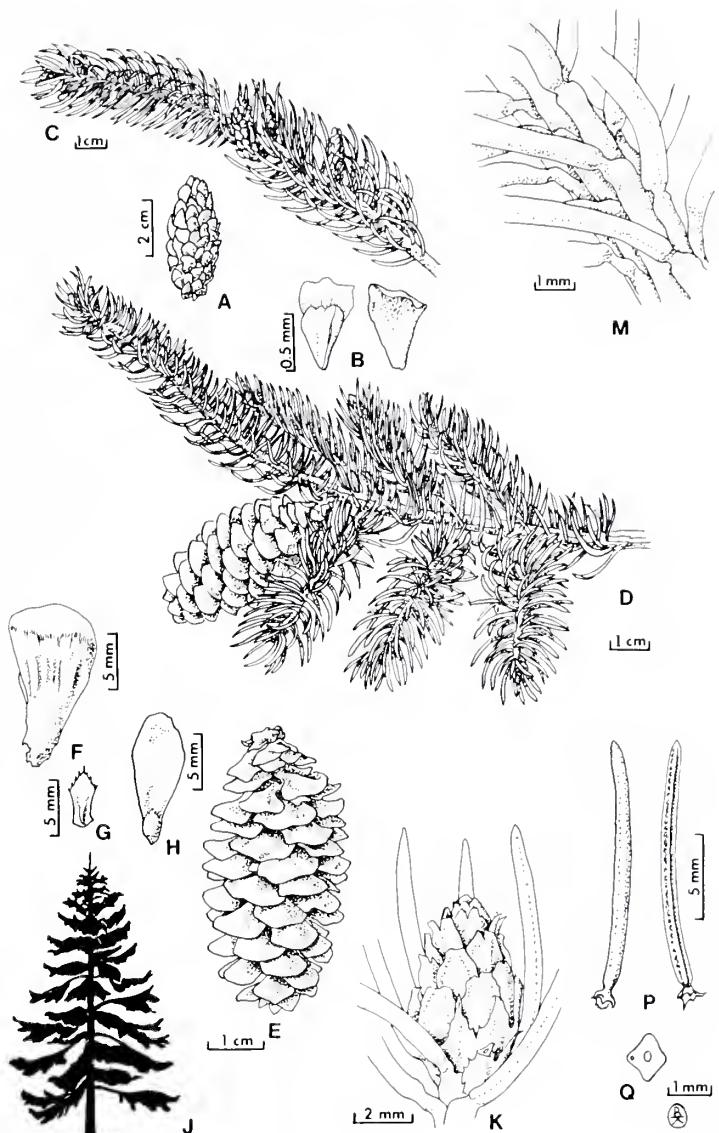
Habit: Small to large tree with a narrow, conical crown that becomes broader, often irregular or open with age, the long, rather stout, upcurving branches persisting on the trunk to ground level except in dense forest conditions where the lower 1/3 – 2/3 of the trunk may be bare. The plants may be shrubby in arctic-alpine situations

Pollination: May-June

Mature Cones Opening: August-September of the 1st season

General Distribution: Newfoundland west to Alaska, south to southern Maine, northern parts of New Hampshire, Vermont, New York, Michigan and Wisconsin, northeastern Minnesota, Manitoba, Saskatchewan and northwestern Montana; disjunct in southeastern Michigan and western South Dakota

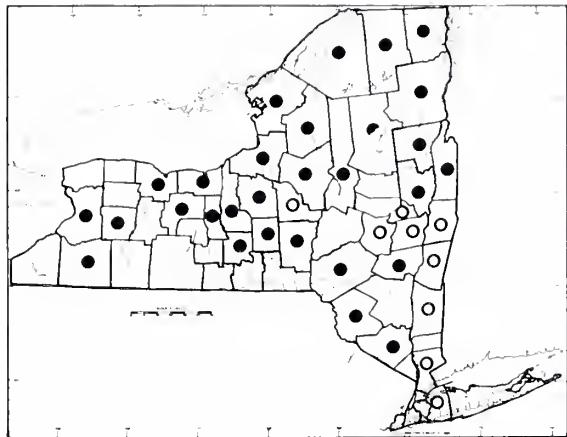
Description: **monoecious;** **female cones** terminal or crowded near the tips of the previous year's growth, red or yellow-green and glaucous when young, oblong-cylindrical, slightly narrowed at the apex, (2.9) 3.4-4.8 (5.4) cm long, (1.8) 2.1-2.3 (2.6) cm wide, brown, mostly deciduous the 1st year; **bracts** oblong or pandurate-spatulate to nearly orbicular, 2-4 mm long, 1.5-2.0 mm wide, the apex somewhat narrowed, denticular or notched, upper margins denticulate, purple becoming light brown at the apex to dark brown at the base; **female cone scales** 80-100, including 8-10 smaller unopened scales at the base of the cone and 10-20 immature or unopened scales at the apex, obovate, nearly orbicular in the upper half, narrowing to a broadly cuneate or wedge-shaped base, concave, thin, 9-12 mm long, about 10 mm wide, the apex rounded (occasionally narrowed) and often broadly



emarginate, curling upwards, the exposed apical regions slightly thickened, brittle, brown, lustrous, the margins entire or sometimes erose; **ovules** divided at the micropylar end; **seeds** obovate, about 2 mm long, 1 mm wide, acute at the base, rounded at the apex, dark brown to almost black, **wing** obovate, wedge-shaped, 6-9 mm long, (2.5) 3.5-4.5 (5.5) mm wide, light brown; **male cones** terminal or subterminal, subgloss, rapidly becoming oblong-cylindrical, 8-12 mm long, red and yellow, pink, red or red-purple; **peduncle** hidden by persistent bud scales; **male cone scales** about 2 mm long; **lamina** wider than long, about 1 mm long, laciniate; **leaves** spirally arranged, with sterigmata twisted so that the leaves are directed upward and crowded on the upper side of the branchlet, linear, incurved toward the branchlet apex, or straight and curved outward or away from the branchlet, 11-17 (23) mm long, about 1 mm wide and thick, acute, sometimes with rigid, callous, sharp tips, green, blue-green or gray-blue, glaucous, persistent 7-10 years, the sterigmata not projecting more than 0.5 mm from the branchlet, the odor strong and considered bitter and disagreeable by some, **adaxial surfaces** each with 4 rows of stomata, **abaxial surfaces** with 3-5 (-7) interrupted and uninterrupted rows of stomata, the rows increasing in number towards the apex; **buds** ovoid with a broad blunt apex, 3-6 mm long, 2-3 mm wide, the lateral equal in size or slightly smaller than terminal buds, light brown or red-brown, only slightly resinous; **bud scales** slightly appressed, later spreading, broadly ovate, 1.5-2.5 mm long, about 1.5 mm wide, the margins ciliate, the 4 basal scales of the terminal bud deltoid with a swollen yellow base and keeled with the midrib usually elevated into a ridge that extends beyond the apex into a short awn, the awn 0.3-1.0 mm long; **branchlets** stout, 1.5-3.5 mm in diameter, orange-brown or light brown the 1st year, becoming darker or remaining orange in subsequent years, ultimately dark brown, gray-brown or gray, grooves usually gray or black by the 2nd year, glabrous or occasionally sparsely rusty-pubescent in grooves of 1st-year branchlets, often glaucous, at least on sterigmata of 1st-3rd year branchlets; **branches** irregular or regularly spaced in whorls, horizontal, then upturned at the tips, with numerous lateral branchlets horizontal or pendulous; **bark** to 1 cm thick on older trees, gray to gray-brown, separating into thin, plate-like scales; **crown** narrowly conical becoming broadly conical, often irregular or open with age, the long, rather stout, upcurving branches persistent to the ground unless in dense forest conditions where the lower 1/3-2/3 of the trunk may be bare; **trunk** 35-75 (-150) cm in diameter, straight with little taper; **trees** 20-25 (-50) m tall, reduced to shrubby or dwarf stature at tree line at high elevation or alpine situations; **root system** spreading, shallow to moderately deep ($2n = 24$).

Infraspecific Variation: Variation in cone and leaf characters is considerable across the range of white spruce. In New York State, cone size is variable but leaf size is rather constant, although orientation and relative flatness of the leaves varies. Leaves are more strongly glaucous at their woody bases, although sometimes the bloom disappears early. The transition from leaf to bud scales is sometimes rapid and sometimes gradual. Some lower bud scales have a scale-like base and a light green foliar apex. Sometimes leaves are more flattened, less glaucous and a darker green, making this species more difficult to distinguish from *P. abies*. *Picea glauca*, in contrast to *P. mariana* and *P. rubens*, with which it is often sympatric, is a relatively recent addition to the flora of New York. In the northern and montane part of the State, post-Pleistocene migration of this western species appears to continue as its range expands (Wright, 1955), while in southern, central and western parts of the State it may be spreading mainly by naturalization from forest plantings. Although white spruce hybridizes frequently with Engelmann spruce, *P. engelmannii* Engelm. ex Parry, in the West, there is little or no hybridization with *P. rubens* and *P. mariana* (La Roi et al., 1968; Little and Pauley, 1958, Wright, 1955). *Picea glauca* var. *albertiana* (S. Brown) Sarg. is a variety from western North America with shorter, wider, darker female cones, rounded female cone scales, smaller, sharply angled bracts and leaves spreading at nearly right angles to the twig.

Importance: The soft fibers of its light, fine-grained, weak wood make white spruce the most valuable pulpwood of northeastern and north central North American forests. Construction lumber and sounding boards for musical instruments are other uses. The roots were used by native Americans for canoes and basketry. Leaves, bark and the other parts of the plant were apparently also used for medicines, poultices, gums and teas. Despite the general tendency of spruces to drop their leaves soon after cutting, white spruce holds its leaves longer, grows rapidly, and supplies a large portion of the Christmas tree market in New York and other northeastern states. White spruce is popular in cultivation as a specimen tree, hedge or windbreak. About half of its 30-40 cultivars are dwarf varieties.



3. *Picea mariana* (Miller) BSP.

Common Names: black spruce, bog spruce, swamp spruce, shortleaf black spruce, bay spruce, eastern spruce, he-balsam, spruce gum-tree, double spruce, shite spruce, water spruce, shortleaf spruce

Type Description: Miller, Gard. Dict. ed. 8, no. 5, 1768

Synonyms: *Abies mariana* Mill., *Picea brevifolia* Peck, *P. nigra* Link

Origin: Native to northern North America

Habitats: Mainly cold slopes, bogs, swamps and lake shores, rarely on drier, better-drained uplands and rocky slopes in association with *Larix laricina* to tree line in the Adirondacks, characteristic of sphagnum-heath bogs in the southern part of its range

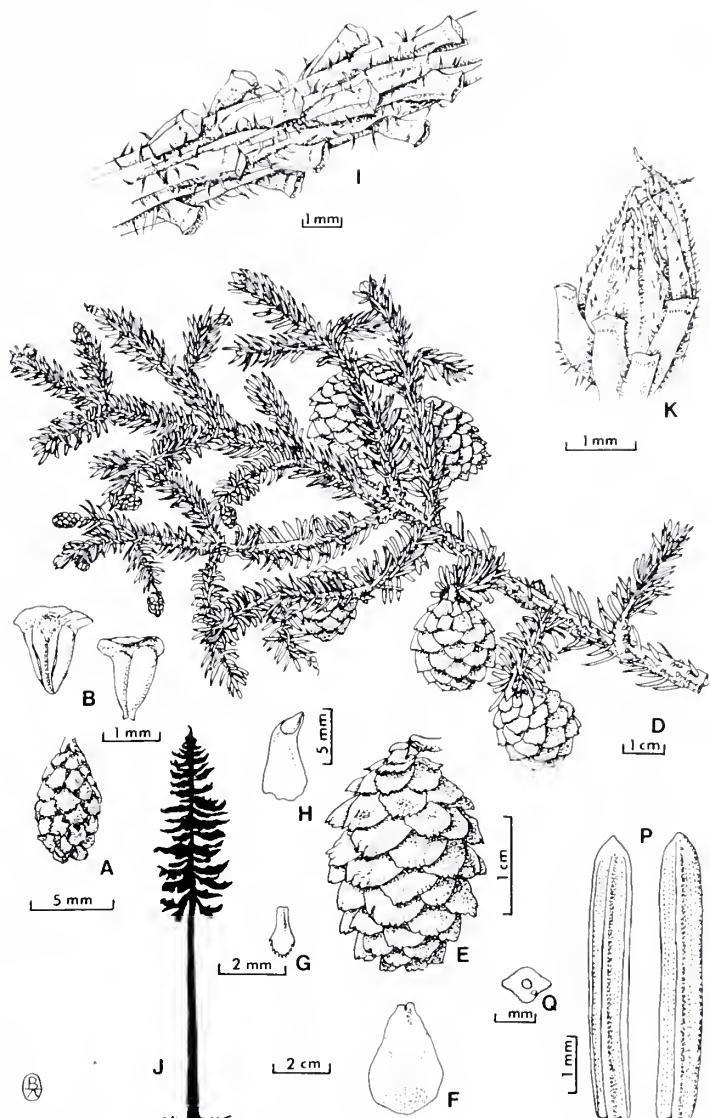
Habit: Medium-sized tree with narrow irregular crown and short branches and narrow, straight trunks or sometimes a prostrate mat on mountain-tops at treeline, usually with dead branches

Pollination: May-June

Mature Cones Opening: August of the 1st season

General Distribution: Newfoundland west to Alaska, south to northern New Jersey, northern Pennsylvania, northern Michigan, northern Wisconsin, northeastern Minnesota, Manitoba, central Saskatchewan, central Alberta and east-central British Columbia; disjunct in southeastern Michigan, southeastern Wisconsin and eastern Minnesota

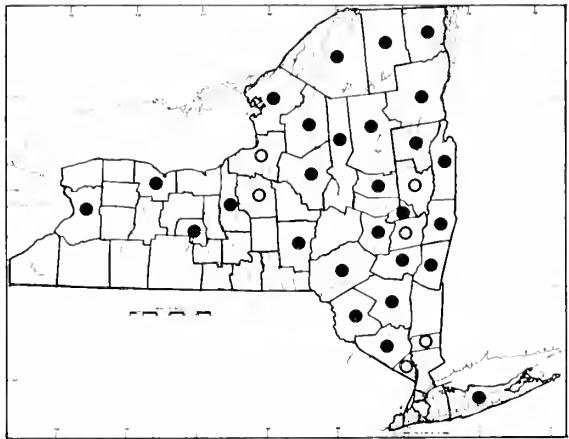
Description: monoecious; female cones terminal or subterminal on the previous year's growth, often crowded. 3-4 mm long at pollination, becoming (1.7) 2.1-2.6 (3.3) cm long, (1.6) 1.9-2.2 (2.4) cm wide, the apex rounded, purple, becoming dark brown, persistent up to 30 years or more; bracts spatulate, about 1 mm long, dark purple, laciniate; female cone scales about 50, including smaller, basal scales and unopened scales at the apex, obovate nearly spatulate, concave, thin, the largest scales in the middle of the cone about 1 cm long, 6 mm wide, the exposed area near the apex slightly thicker, apex thinner, light brown to dark brown or almost black, minutely puberulous or glaucous on the adaxial surface near the apex, upper margins and apex erose, finely and regularly toothed (or rarely entire), basal margins entire; seeds obovate, about 2-3 mm long, 1.2-2.2 mm wide, acute at the base, light brown to dark brown, sometimes mottled, wing 4-7 mm long, 2.5-4.0 mm wide, obliquely rounded at the apex, narrowed at the base; male cones globose when young, becoming oblong-conical, 8 (-10) mm long, about 3 mm wide; pedun-



cle 1-2 mm long, mostly concealed; **male cone scales** 70-100, 1-2 mm long, brown to light red-brown or dark red; **lamina** about 0.6 mm in diameter, laciniate; **leaves** spirally arranged, radiating from all sides of the branchlet, slightly curved, 6-13 mm long, 1.5-2.8 mm wide, acute, infrequently acuminate, sometimes obtuse, sometimes short, sharp, with callous tips, blue-green, green or dark green, glaucous, lustrous, persistent at least 5-6 years, **adaxial surfaces** with 5-6 rows of stomata each, **abaxial surfaces** usually with 4 rows of stomata each; **buds** ovoid, 3-5 mm long, the lateral ones often smaller than the terminal bud, acute, red-brown to light or dark brown, slightly resinous; **bud scales** ovate, concave, 1-2 mm long, 1.0-1.5 mm wide, ciliate, puberulous, the adaxial surface of the base swollen and yellow, the midrib of the outer scales of terminal buds and occasionally of the upper lateral buds extended into a short-hispid awn about 1-2 mm long, usually surpassing the apex of the bud; **branchlets** grooved due to raised margins of the strongly decurrent leaf bases, yellow-brown or pale red-brown the 1st year, becoming light cinnamon to orange-brown the second and third years, brown, dark brown, gray-brown, gray or blackened thereafter, densely glandular pubescent, the hairs pale or red-brown becoming darker and finally deciduous; **branches** irregularly arranged, pendulous then turning up at the tip, ascending only near the very top of the tree, short, persistent to the ground in open conditions or extending halfway down trunk in forested conditions, the lowest branches sometimes layering; **bark** 7-15 mm thick, fissured, covered by irregular, thin, close scales, red-brown, becoming gray or gray-brown with age; **crown** frequently irregular, conical; **trunk** 30-50 (-100) cm in diameter, straight, with little taper; **trees** to 20 (-30) m tall, sometimes dwarfed under severe conditions; **root system** spreading, shallow, flat, not windfirm ($2n = 24$).

Infraspecific Variation: This species is variable in growth habit, with irregular to quite symmetrical crowns and tall to short and stunted growth in bogs and at tree line, where plants a few feet tall sometimes bear cones. Soils and microclimate can drastically affect morphology, so that this species can easily be confused with *P. rubens*, especially where they grow together at lower elevations on the margins of bogs and swamps. These species hybridize in nearly every place where they are sympatric (Gordon, 1976; Heimburger, 1939; Manley, 1972, 1979), although perhaps infrequently, yielding inferior adaptive characters. The color shape and length of leaves and the density and degree of glandularity of pubescence are critical characters that show the greatest variation in *P. mariana*. Cone size is reasonably constant, although slightly larger cones, borne occasionally towards the tips of branchlets, can look much like those of *P. rubens*, whose cones are very nearly the same size and shape. *Picea mariana*, although not completely restricted to bogs and swamps, is not nearly as prevalent in mesic high-altitude sites where red spruce is much more likely to be present. The shorter, curved, glaucous, blue-green leaves, smaller, persistent cones and ability of plants to layer help to distinguish black spruce from the similar and often sympatric red spruce.

Importance: The most important use of black spruce is for pulp, although it is not harvested nearly as much as other spruces for this purpose, because of its slow growth. The light, soft, weak, stiff, straight-grained wood is similar to other spruces, and it is used for canoe paddles, oars, masts, ladder tails and boat construction. Chewing gums, beer, tea and medicine were some colonial and pre-colonial uses of black spruce. Some dwarf horticultural varieties have been developed, but, otherwise, the trees rarely make good ornamental specimens, even under the best of conditions in botanical gardens.



4. *Picea rubens* Sargent

Common Names: red spruce, he-balsam, yellow spruce

Type Description: Sargent, Silva, vol. XII, p. 33, 1898

Synonyms: *Picea rubra* (Duroi) Link, *P. australis* Small

Origin: Native to eastern North America

Habitats: The common spruce of the Adirondacks and Catskills, where it thrives in shallow, well-drained soil, cold, moist mountain slopes, sometimes at the peaks, and, at the margins of streams and swamps with *P. mariana* and *Larix laricina*, often in association with beech, maple and yellow birch. Occasionally it is found at high elevations, rarely near bogs in central New York, but an important tree of bogs in southern and western New York. Most southerly populations destroyed by a Long Island hurricane, over five decades ago

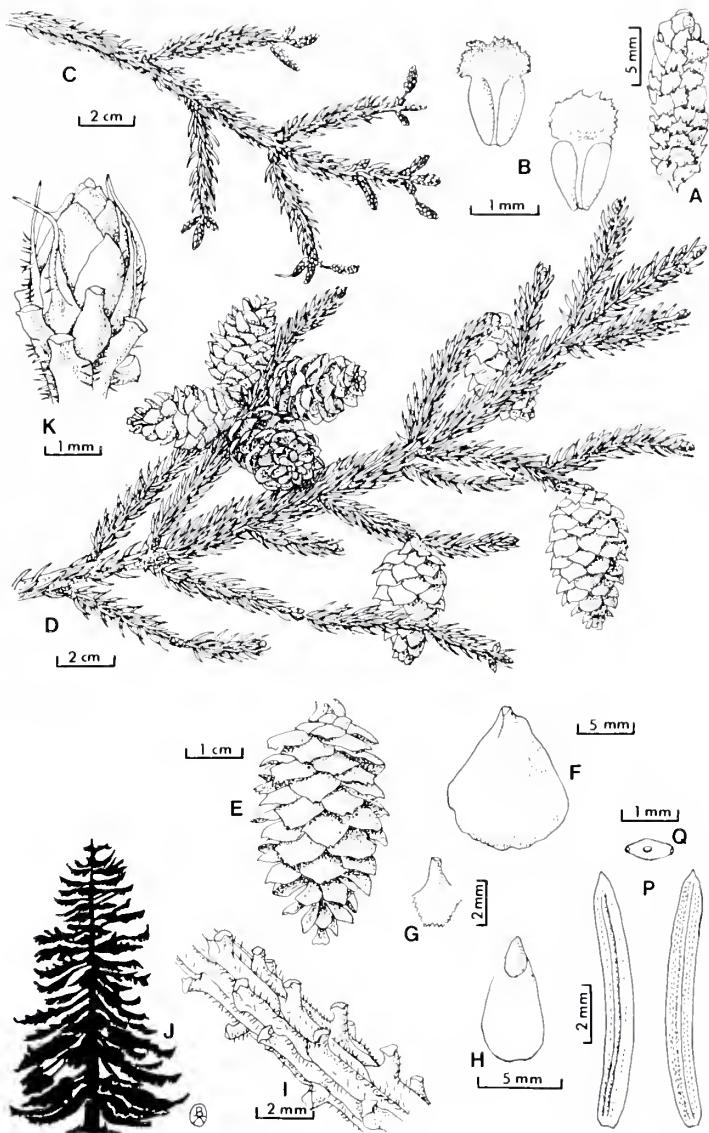
Habit: Small to medium-sized, slow-growing tree with a narrow, irregular to symmetrically conic crown and a trunk of little taper (dwarf and shrubby at high elevations)

Pollination: April-May

Mature Cones Opening: August-September of the 1st season

General Distribution: Nova Scotia west to southeastern Quebec and southeastern Ontario, south to northern New Jersey north-eastern Pennsylvania and south in the Appalachians to western North Carolina and eastern Tennessee

Description: monoecious; **female cones** terminal or scattered along growth of the previous year, occasionally crowded, (2) 3.3-3.8 (4.2) cm long, (1.9) 2.2-2.5 (2.7) cm wide, green, dark red-green, purple or brown and glaucous, becoming light brown to dark brown, deciduous the 1st winter or spring after ripening, occasionally remaining on the tree another year; **bracts** spatulate or nearly pandurate, 2-3 mm long, about 2 mm wide, finely laciniate, purple becoming brown, glabrous, very soon surpassed by the scales; **female cone scales** 50-60, not including 4-6 much smaller scales at the base of the cone and many unopened scales toward the apex, broadly obovate, adaxially concave, stiff, the middle and largest about 12 mm long and 11 mm wide, thickened near the apex, then thinner and flexible at the margins, the apex rounded and entire, or sometimes minutely erose when young, red-brown, glabrous, except sometimes minutely red-puberulous around the tips of the seed wings; **seeds** wedge-shaped or obovate, cuneate at the base, 1.5-3.0 mm long, dark brown, **wing** wedge-shaped or obovate, 6-7 (-9) mm long, 3-5 mm wide, light brown; **male cones** oblong-cylindrical, 14-19 mm long, 5-6 mm wide, purple-brown to dark purple; **peduncle** 4-5 mm long; **male cone scales**



60-75 (-100), 1.3-1.8 mm long, 1.2-1.5 mm wide; **lamina** 1.2-1.5 mm long, the margins erose to laciniate or irregularly toothed, light brown; **microsporangia** light brown to yellow-brown; **leaves** 10-12 (-15) mm long, 0.6-1.0 mm wide, straight, acute, sometimes mucronate, green or light green to nearly yellow-green, aromatic, with the odor of orange-rind, persistent at least 6 years, stomata arranged in 4-6 longitudinal rows on the adaxial surfaces and 2-3 rows on abaxial surfaces; **buds** ovoid, the terminal sometimes larger than the lateral, 3-5 mm long, 2.0-2.5 mm wide, dark purple to dark brown, often light brown at the base; **bud scales** ovate, about 2 mm long, 1.5 mm wide, acute, carinate and swollen at the base, light brown or yellow-brown, sparsely hispid or glabrous, but consistently becoming glabrous towards the apex, persistent, the outer scales of terminal buds aristate-acuminate, usually surpassing the bud apex, the extension of the midrib or awn at least 2 mm long and hispid, sparsely hispid or glabrous but becoming glabrous towards the tip; **branchlets** opposite or irregularly arranged, usually stout, deeply furrowed, rough to the touch because of the sterigmata or woody projections at the leaf bases, 1-4 mm in diameter, pale yellow to light red-brown the 1st year, becoming red-brown, orange-brown or brown the 2nd year, brown or gray-brown thereafter, glandular-pubescent, rarely glabrous, the hairs pale red-brown to brown, persistent, glands soon deciduous; **branches** numerous, irregular, drooping slightly, then turning up at the tips, the upper branches slightly ascending; **bark** 7-15 mm thick, red-brown, fissured and covered by irregular, thin, close, flaky scales; **crown** narrowly conical; **trunk** reaching 1 m in diameter, with very little taper, the branches persistent on the stem and clothing it to the ground, or lacking on the lower 2/3 of the tree when crowded; **tree** to 30 m tall (often dwarfed and shrubby at high elevations); **root system** shallow, wide-spreading ($2n = 24$).

Infraspecific Variation: Much of the morphological variation in red spruce is mediated by environmental influences (Wright, 1955). Leaves and cones may be shorter when the tree is growing in saturated soils, thereby obscuring its distinction from black spruce, with which red spruce sometimes grows and naturally hybridizes. Introgressive hybridization between these species was initially thought to be extensive, but hybrid vigor is so weak that the chance for establishment of hybrid populations is small, and gene flow is not stronger in one direction than another (Gordon, 1976; Manley, 1979). Crown form, branch angle and phenology are some principal characters that show hybrid intermediacy (Khalil, 1987), while leaf length, degree of straightness of the leaves, leaf color and cone size are variable within each species. Longer, straighter, less glaucous or non-glaucous leaves, larger, more lustrous red-brown cones that are early-deciduous (after one or at most two years) and lack of layering, in most cases, reliably distinguish red spruce from black spruce. As with some other species, the range of *P. rubens* has expanded into the Northeast from northwestern refugia as well as from the south following Pleistocene glacial events. However, this range is probably shrinking, since *P. glauca* and hardwood species are now more successful as colonizers of land where red spruce has been harvested (Manley, 1972; Wright, 1955). This is true despite greater environmental tolerances of red spruce and its success in mixed spruce forests.

Importance: Red spruce has been an important source for sounding boards in musical instruments, because of the excellent resonant quality of its light, soft wood that is also weak and close-grained. These same qualities have restricted the use of its lumber mostly to crates, boxes and a source of pulp. Native Americans used the pitch in making canoes, and a variety of medicinal concoctions. The logs have been used for masts of ships, and the roots in construction of boat hulls. The tree is not popular as an ornamental, because of its slow growth and the cool, moist habitat required to attain healthy appearance.

Cupressaceae (Cypress Family)

The Cupressaceae: a family of mostly small trees and shrubs (to large trees) with 130 species in 21 genera distributed worldwide. Six genera are monotypic, while three genera, *Juniperus* (ca. 60 spp.) of north temperate areas of the globe, *Cupressus* (15 spp.) of western North America, Central America, Asia and eastern Europe, and *Callitris* (14 spp.) of Australia represent about 70 % of the species in the family. Only five species of Cupressaceae, representing three genera, *Juniperus* (3 spp.), *Chamaecyparis* and *Thuja*, are native in northeastern North America. The family is better represented in western North America, where *Cupressus* and *Calocedrus* also occur. The remaining 16 genera are widespread, often with disjunct distributions, in Africa, Australia, eastern Asia and South America. The genera *Cupressus*, *Microbiota*, *Platycladus* and *Thujopsis* (and the artificial hybrid genus, *xCupressocyparis*) are rarely grown in cultivation in New York State. Several genera of Cupressaceae have species that were once, or remain, important in timber production. Many species have proved to be excellent ornamental subjects. *Juniperus*, in particular, has provided a source of vast nursery production. *Juniperus* is also the natural source for flavoring in gin and cedarwood oil. Oil of cedar is extracted from *Thuja occidentalis* L. Recent research, including Hart's (1987) cladistic analysis of conifers, suggests that most of the Taxodiaceae should be included in the Cupressaceae (Eckenwalder, 1976; Hart and Price, 1990; Price and Lowenstein, 1989). Complete fusion of the bract and scale in the seed-scale complex, similar embryological features, the same chromosome number and non-winged pollen grains lacking prothallial cells are common characteristics of the two families that support their merger. Of the Taxodiaceae, a family of 16 species, native to southeastern

and western North America, southeastern Asia and Australia, only one genus (*Sciadopitys*) can not be included in this recent, broader concept of the Cupressaceae. This is not surprising, since *Sciadopitys* has often been placed in its own monotypic family. *Taxodium distichum* (L.) Rich., baldcypress, of wide distribution in swamps and bayous of the southeastern United States, is not native in New York State, although it is frequently cultivated and has been reported as a rare escape. *Cryptomeria*, *Cunninghamia*, *Metasequoia* and *Sequoiadendron* are other genera of the Taxodiaceae cultivated, albeit rarely, in New York State.

FAMILY DESCRIPTION

Evergreen trees or shrubs with spreading to compact conical crowns with short, slender or stout branches and lateral branchlets that are rounded or flattened into pendulous, horizontal or ascending sprays or fan-like clusters. The bark of trunks and large branches of mature trees is fibrous, shredding or peeling in strips. In most genera, plants bear juvenile leaves as well as dimorphic adult leaves, usually with 1 resin canal. Juvenile leaves are whorled to opposite-decussate, linear, linear-lanceolate or sometimes nearly ovate, often subulate, entire, usually concave, with longitudinal rows of stomata in a wide band along the center of the adaxial surface, usually pungent. Juvenile leaves are more prevalent on seedlings, young plants or young, rapidly growing shoots of mature plants, often lacking altogether on mature plants. Adult leaves are often mixed with juvenile leaves on the same branchlet, and transitional leaves are sometimes present. They are small, usually scale-like, sometimes linear, subulate or awl-shaped, entire or minutely serrulate, persistent, decurrent and completely clothing the branchlet. Adult scale-like leaves are opposite (or sometimes whorled), decussate, imbricate, appressed to the branchlet, sessile, the apex sometimes slightly diverging, acute or obtuse, glabrous, entire or minutely serrulate. Some are flattened facially and some bilaterally on the flat branchlets, their basal margins connivent, even if only at the concealed extreme base. The stomata occur in a few short longitudinal rows on each side of the keel, often hidden by the imbricated leaves below. Adult linear leaves are usually whorled, pungent, entire, adaxially concave, with the stomata in a longitudinal band of several rows traversing the length of the leaf on the adaxial surface. The family contains both monoecious and dioecious species. The very small subglobose or oblong male cones are terminal (or lateral) and usually deciduous in the 1st year, the (2-) 6-24 peltate male cone scales with 2-6 (-10) longitudinally dehiscent sporangia, borne adaxially or abaxially on the lower margins, the lamina or apical portion usually about 1.5 mm in diameter, the stalk 0.1-0.3 mm long or lacking. The pollen lacks wings or bladders. Female cones mature in the 1st, 2nd or 3rd year after initiation and sometimes persist for many years after dispersal of the seeds. They are axillary on short, scaly, lateral branchlets or peduncles, globose, subglobose or oblong, with (4) 6-12, spirally arranged ovuliferous scales that are opposite or whorled, peltate or imbricate and flattened, fleshy or woody, and connate or free. The bracts are minute and so fused to the ovuliferous scale that they are macroscopically indistinguishable. The 1-12 (-20) ovules per scale are erect, 2-lobed or 2-pronged, with the micropylar end facing away from the stalk of the female cone. Seeds are wingless or with 1-3 wings, and embryos have 2-6 cotyledons. The chromosome number for the family is uniformly $2n = 22$.

KEY TO GENERA

1. Female cones fleshy, berry-like, globose, green, becoming blue or blue-black, the scales never separating at maturity; ultimate branchlets terete; adult scale-like leaves keeled, but not compressed 1. *Juniperus*
1. Female cones woody, globose, conical or oblong, green, becoming brown or gray, the scales separating at maturity, peltate or imbricate; ultimate branchlets flattened; adult scale-like leaves compressed bilaterally or facially (2)
2. Female cones globose, the scales peltate; margins of the lateral leaves connivent beyond the apex of the overlapping facial leaf 2. *Chamaecyparis*
2. Female cones oblong or conical, the scales oblong and imbricate; margins of the lateral leaves not connivent beyond the apex of the overlapping facial leaf 3. *Thuja*

1. JUNIPERUS

Common Names: juniper, savin, cedar

Authority: Linnaeus, Species Pl. II, p. 1038, 1753

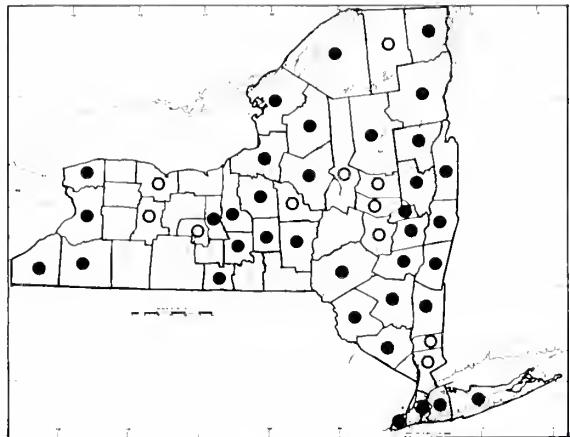
A genus of about 60 species of shrubs and small (to large) trees of the Northern Hemisphere, with about 25 species native to western North America and four species in eastern North America, of which three species occur in New York. Junipers display great variation in growth forms, and horticulturalists and plant propagators have capitalized on this variability to serve many ornamental purposes. *Juniperus* is one of the most widely cultivated conifer genera with over 500 named cultivars in use as hedges, ground-covers, plantings next to buildings, on stone walls in rock gardens and dwarf conifer gardens. Distinctive features are the fragrant or musky foliage, the berry-like, usually glaucous, blue or blue-black cone, and the often persistent, sharp,

linear, needle-like juvenile leaves. Resinous juices of the “juniper berry” have been used for flavoring in gin distillation, and wood resins are used in production of cedarwood oil.

Description: dioecious (rarely monoecious); **female cones** solitary, terminal, on short branchlets (with scale-like leaves) or obscure peduncles (more evident in *J. communis*, which has contrasting, linear leaves) from lateral sterile branchlets borne on the 1st or 2nd year branchlets, erect or pendulous, globose, berry-like, fleshy, green becoming blue or blue-black at maturity, usually glaucous, maturing the 2nd or 3rd year after initiation, resinous, deciduous in the first or second year after ripening; **peduncles** clothed by 2-10 scale-like, opposite, decussate, ovate, appressed or spreading, imbricate leaves, 1-6 mm long; **sterile scales** 2-6, fleshy, combining with the fertile scales to form the berry-like cone; **fertile female cone scales** 2-6, each bearing 1-2 ovules, peltate, uniting and becoming fleshy, often with a caducous muco or acute process at the center of the outer surface; **seeds** 1-12, ovoid, acute or obtuse, variously angled, glabrous, light brown, roughened or grooved by the impression of the resin canals of the scales, the hilum 2-lobed, **wings** lacking; **cotyledons** 2 (-6); **male cones** solitary, terminal on lateral branchlets 1-8 (-11) mm long, on the previous year's growth, or axillary and sessile, short oblong-cylindric, 2.0-3.5 mm long, 1.5-2.0 mm wide, light brown to light red-brown; **sterile scales** lacking; **peduncles** naked, abbreviated, concealed by leaves of the branchlet; **male cone scales** 6-12, peltate, often reduced in size at the apex of the cone; **lamina** ovate to orbicular and often surpassed by the swelling and dehiscing microsporangia; **stalk** reduced or not evident, positioned at the lamina margin; **microsporangia** 3-6, attached at the juncture of the stalk and the adaxial surface of the lamina near its basal margin, expanded towards the base of the lamina so that the tips are visible from its abaxial surface, dehiscing longitudinally; **leaves** usually dimorphic (except in *J. communis*), with gradual or sudden transition between adult and juvenile leaves of the same branchlet, the transition often merely an increase in leaf length and greater divergence from the branchlet, transition leaves mostly present on leading shoots and main older branchlets; **juvenile leaves** whorled or occasionally opposite and decussate, sessile, decurrent, imbricate, appressed to and completely covering the branchlet; **adult (scale-like) leaves** not flattened, 2-3 mm long, sometimes achieving lengths over 1 cm on rapidly elongating 2nd-year shoots, acute, the apex subulate in young plants or on rapidly-growing shoots (on 2nd and 3rd year shoots the divergent apex becoming thickened, more keeled and sometimes pungent), bright green, becoming brown and hardened, glabrous, entire, facial and lateral leaves similar, distinguished only by the angle of view, margins of lateral leaves meeting over the basal portion of each facial leaf (this juncture usually obscured by the apical portion of the facial leaf below), with or without raised or depressed resin glands or pits near the middle of the abaxial surfaces of facial or lateral leaves, a few short, longitudinal rows of stomata at the base on each side of the keeled abaxial surface and nearly or completely covered by the apical half of the leaves below; **adult (linear) leaves** (of *J. communis*) whorled, abruptly joined to the branchlet at their broadened bases, concave, pungent, broadly keeled, often appearing swollen on the abaxial surface, the stomata in rows in a broad longitudinal band on the adaxial surface; **buds** scaly or naked; **branchlets** terete, completely covered with leaves, the older ones with grooves or lines formed by persistent adult leaves and decurrent juvenile leaves, the leading shoots and main branchlets with juvenile leaves or longer, more pungent and divergent adult leaves, lateral branchlets with adult leaves only and mostly deciduous; **branches** erect, horizontal or pendulous to prostrate, slender; **bark** usually thin, shedding in long strips, light-brown or gray-brown; large or small **trees** or shrubs; **root systems** fibrous, shallow to deep ($2n = 22$).

KEY TO SPECIES

1. Leaves linear, in whorls of 3, divergent; berry-like female cones axillary 1. *J. communis*
1. Leaves mostly scale-like, nearly as wide as long, opposite or whorled, appressed; berry-like female cones terminal (2)
 2. Stems prostrate; berry-like female cones pendulous, 6-10 mm wide; seeds 3-5 2. *J. horizontalis*
 2. Stems erect; berry-like female cones erect, 5-6 mm wide; seeds 1-2 3. *J. virginiana*



1. Juniperus communis L.

Common Names: juniper, common juniper, ground juniper, gorst, fairy-circle, horse-savin, hackmatack

Type Description: Linnaeus, Species Pl. II, p. 1040, 1753

Synonyms: *J. communis* var. *siberica* (Burgsdorf) Rydb., *J. siberica* Burgsdorf (see also under var. *depressa*)

Origin: Circumboreal, spanning North America and Eurasia

Habitats: Diverse, from open, stony hillsides to exposed rocky slopes, old fields, pastures, dry, open woods. In dry, poorly illuminated calcareous or acidic soils, swamps, muck or sand up to altitudes of 3,000- 4000 m; also in bogs and limestone crevices of alvar vegetation areas

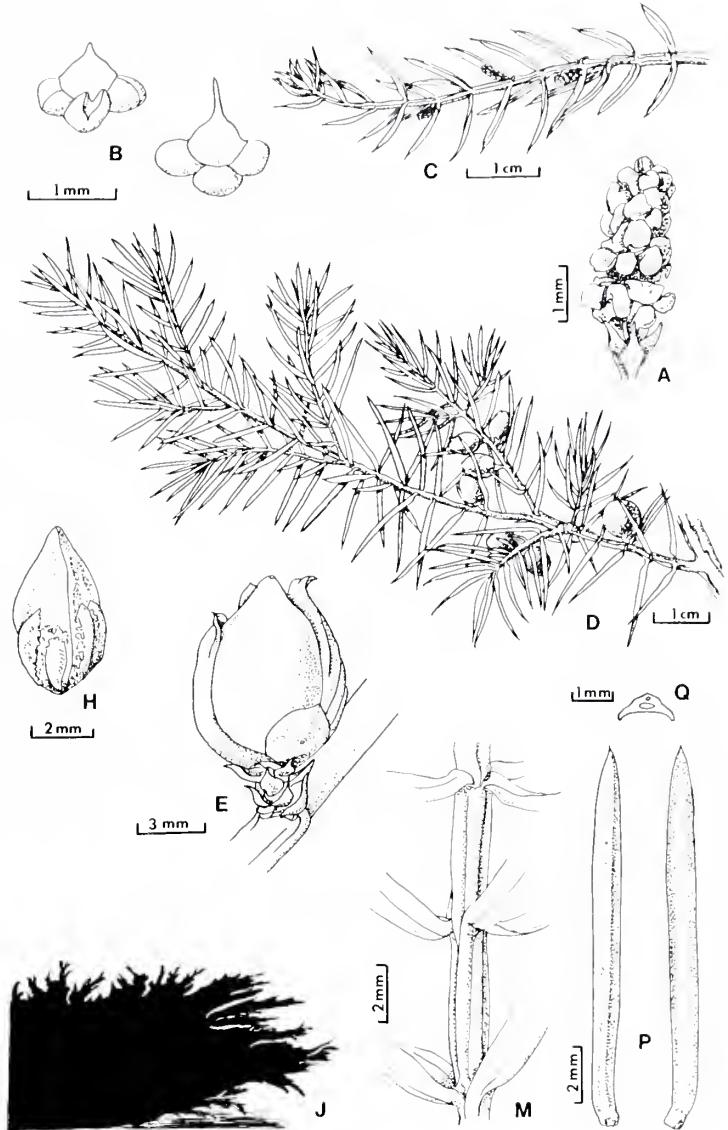
Habit: Shrub or small tree, often forming dense wide mats, with an irregular, dense to open crown, the trunk small and single or multiple and spreading, the many branches horizontal to prostrate, sometimes adventitiously rooting at ground level, their tips arching upward

Pollination: May

Mature Cones: Variable in ripening and persistence, usually August of the 3rd season

General Distribution: Circumboreal north-temperate and widely distributed in many forms throughout the Northern Hemisphere, from arctic Asia to Japan, the Himalayas and the mountains of the Mediterranean; Newfoundland west to Alaska, south to Oregon and east to Pennsylvania with numerous disjunct populations from California across the Rocky Mountains, south to Arizona and North Texas, northern South Carolina and northern Georgia

Description: dioecious; female cones borne on short, scaly, lateral branchlets or peduncles in axils of leaves of 1st-year branchlets, but not maturing until the 3rd year, drying and often persisting until the 4th or 5th year, erect, spreading, overtopped by the lower scales during the 1st year, globose, subglobose or short-oblong, mostly 7-10 mm in diameter, dark blue to almost black, with pink tinge at the apex of the scales and apex of the ovule in the 1st year, glaucous, sweet, mealy, fleshy, berry-like; peduncles 1-2 mm long, the scale-like leaves 10-20, spreading, cuspidate, concave, pale green, becoming chartaceous; sterile scales 5-6, ternate; fertile female cone scales 3, minute, fleshy, developmentally fused with sterile scales to form a berry-like cone; ovules 1 per scale; seeds (1-) 3, ovoid, irregularly angled or flattened, acute, deeply pitted with numerous thin-walled resin glands, outer coat thick and bony, the inner membranaceous wings lacking; cotyledons 2; male cones axillary, on short lateral branchlets or



peduncles, oblong, subglobose to globose, 2.0-3.5 mm long, 1.5-2.0 mm wide, brown; **peduncle** minute, less than 0.5 mm long, covered with 3-6, opposite, decussate, ovate, concave, swollen, green, scale-like adult leaves 0.6-1.0 (-2) mm long; **male cone scales** 8-12, about 1 mm long and about as wide, rounded or acuminate-cuspidate; **stalk** at the margin of the lamina, 0.1-0.2 mm long; **lamina** deltoid or ovate-deltoid, the apex sometimes with a cusp about 0.5 mm long that curls or presses in along the cone axis, often obscured by microsporangia of adjacent male cone scales; **microsporangia** 3-5, about 0.5 mm long; **leaves** in whorls of 3, all linear-lanceolate (except for 6 scale-like, opposite and decussate, imbricate, appressed, concave, ovate leaves about 1 mm long, on the abbreviated lateral branchlets that bear male and female cones), articulating at the point where they become decurrent on the branchlet, divergent, often spreading nearly at a right angle to the branchlet, (8-) 10-13 (-15) mm long, 1.5-2.0 mm wide, long-acuminate, pungent, stiff, green turning bronze or brown in winter, glabrous, entire, disarticulating and falling mostly in the 4th year, leaving hardened, decurrent bases that remain on the branchlets for several more years before flaking off, **adaxial surface** concave, with a raised or swollen, light brown area at the point of articulation of decurrent base, with a single, broad, longitudinal, white band consisting of about 15 rows of stomata, **abaxial surface** bluntly keeled by the raised midrib, but also grooved in the middle of the keel, lacking stomata; **buds** ovoid, about 3 mm long, acute, loosely covered by adult or scale-like leaves; **branchlets** completely covered by the decurrent leaf bases, the young branchlets therefore appearing 3-angled, older branchlets terete, about 1 mm in diameter the 1st year, to 4 mm in diameter by the 4th or 5th year, glabrous, lustrous the 1st and 2nd seasons, light yellow or orange-yellow the 1st year, becoming red-brown or brown the 2nd year, dark brown to gray thereafter, rough or scaly with short, raised, swollen areas formed from the midribs of the persistent decurrent leaf bases, with vertical lines or grooves formed by the separated margins of the decurrent leaf bases, with broken or complete concentric rings where the leaf disarticulates from its base and the twig; **branches** erect, forming an irregular open bush, or horizontal to prostrate with erect tips; **bark** thin, about 2 mm thick, dark red-brown, separating irregularly into many loose papery persistent scales; **crown** irregular, dense or open, with many erect, horizontal to prostrate branches that turn up at the tips; **trunks** up to 25 cm in diameter on erect plants with a single trunk; **shrub** 1-3 m tall, often forming dense mats as wide as 7 meters, or infrequently a **small tree** 4-7 meters tall; **root system** dense, dark and matted; adventitious roots often present where decumbent branches touch the ground.

Infraspecific Variation: A widespread, polymorphic species. Several varieties and subspecies of *J. communis* have been named, based on growth-habit, branchlet length and aspect, size, shape and other characters of the leaves, as well as fruit and seed size. Over 50 cultivars have been developed by selecting for these variable characters as well as foliage color and crown density. The following varieties occur in the wild in New York State.

KEY TO VARIETIES

1. Shrubs erect, often becoming small trees, 2-12 m tall; leaves 12-21 mm long; berry-like cones 5-8 mm in diameter 1a. *J. communis* var. *communis*
1. Shrubs decumbent or forming prostrate mats, rarely up to 1.5 m tall; leaves 8-18 mm long; berry-like cones 6-10 mm in diameter 1b. *J. communis* var. *depressa*

1a. *J. communis* L. var. *communis*

Common Name: common juniper

Habitats: Dry soils of woods and clearings

Habit: Small tree or shrub with conical, dense to somewhat open crown

1b. *J. communis* L. var. *depressa* Pursh

Common Names: spreading or prostrate juniper

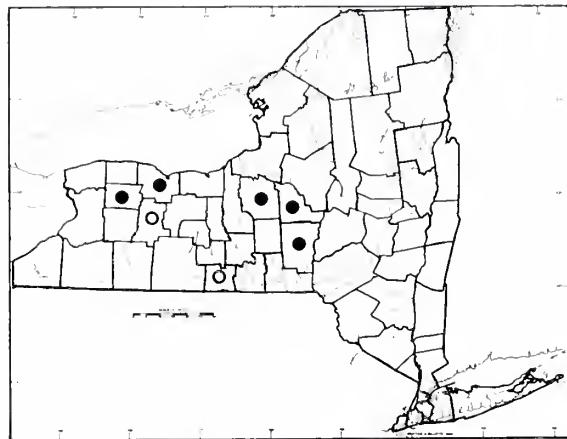
Synonyms: *J. canadensis* Burgsdorf, *J. communis* var. *canadensis* (Burgsdorf) Loudon, *J. communis* var. *saxatilis* Pallas, *J. depressa* (Pursh) Raf., *J. sibirica* Burgsdorf

Habitats: Rocky, poor soils of open woodlands, clearings, pastures and ledges

Habit: Decumbent or prostrate with erect branches ascending from the procumbent base. Forming mats up to several meters in diameter, often less than a meter high

Importance: The common juniper is an important part of our ornamental flora, frequently found in rock gardens, as a ground cover, in plantings next to buildings and in dwarf conifer gardens. Numerous horticultural varieties have been bred and sold in

nurseries around the world. In the wild, the berries provide an important food source for birds and mammals. Juniper wood has long been used in Europe, considered an excellent fuel, sometimes used to smoke pork. Because of its durability, it is preferred in some areas for staking vines, and a dye may be made from the twigs. The principal commercial use of juniper has been the extraction of volatile oils from the “berry” for the production of gin. The berries and leaves have served various other purposes, used in gums and varnishes and as a flavoring for beer, jams and spices. Juniper has been used as a coffee substitute in Europe and by Native Americans mostly as a diuretic, but also for a variety of other medicinal treatments, including poultices, treatment



of snake bite, intestinal parasites, menstruation, gas, kidney and respiratory problems.

2. *Juniperus horizontalis* Moench

Common Names: creeping juniper, prostrate juniper, creeping savin

Type Description: Moench, Meth., p. 699, 1794

Synonyms: *J. hudsonica* Forbes, *J. prostrata* Pers., *J. repens* Nutt., *J. sabina* var. *horizontalis* Hort., *J. sabina* var. *procumbens* Pursh, *J. sabina* var. *prostrata* Loudon, *J. virginiana* var. *prostrata* (Pers.) Torr., *Sabina horizontalis* (Moench) Rydb., *S. prostrata* (Pers.) Antoine

Origin: Native to North America

Habitats: Often on dolomitic soils in New York State. Elsewhere, also on acidic soils in dry or wet sites, mostly on sandy, gravelly shores and dunes, rocky banks, rocky woods, bogs, frequently in fir or alder thickets.

Habit: Small, procumbent or prostrate, often creeping shrub with slender, trailing branches

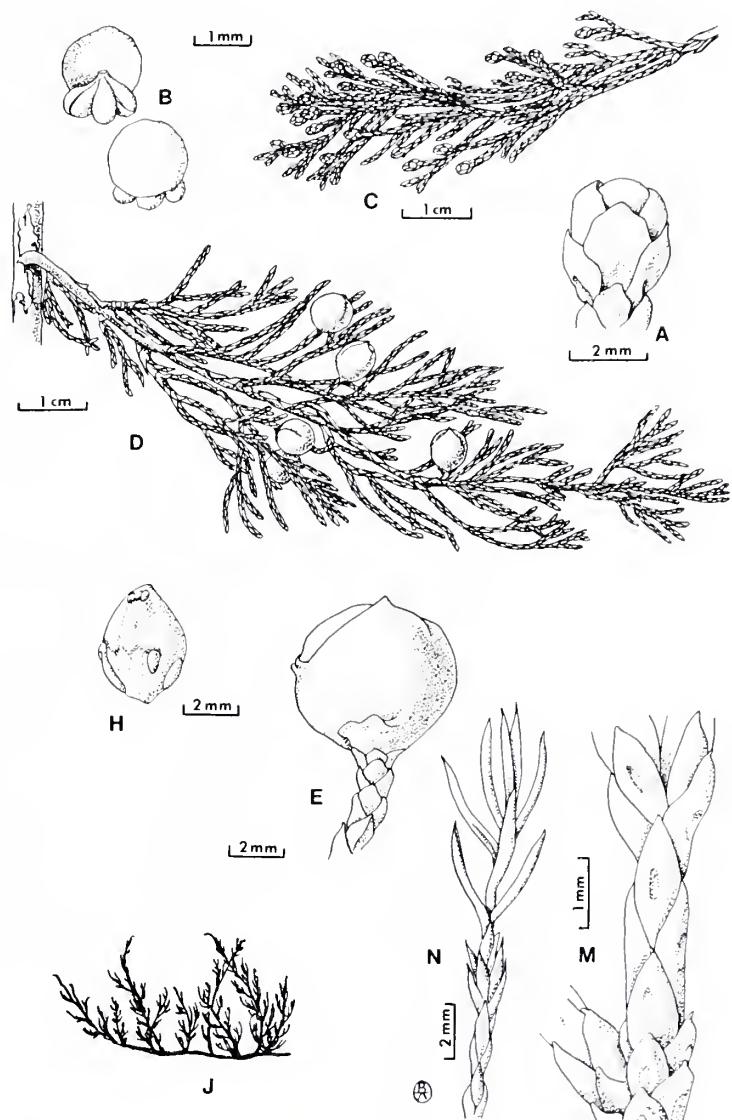
Pollination: May

Mature Cones Opening: August-October of the 2nd or 3rd season

General Distribution: Newfoundland west to Alaska, south to New Hampshire, southwestern Vermont, northwestern New York, Michigan, northern Illinois, northern Iowa, Minnesota, northern Nebraska and Wyoming

Rarity Status: *Juniperus horizontalis* is listed and ranked E (endangered) under New York State law. It is ranked G5, S1 by the New York State Natural Heritage Program, which means that it is globally secure, but currently not known to be extant at more than five locations in the State.

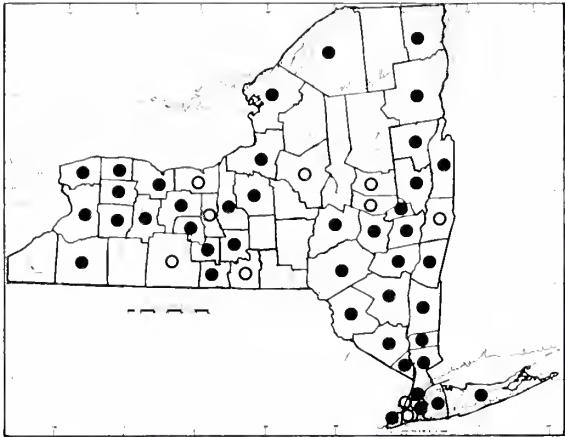
Description: dioecious; female cones terminal, almost sessile on short, pendulous or recurved lateral branchlets, globose, 6-8



(-10) mm in diameter, green the 1st year, red-purple to dark blue-purple the 2nd year, blue-black the 3rd year, glaucous, glabrous, with 2-4 minute or slightly larger, spreading mucros (or remnants of the cone scales), drying and falling in the 4th to 6th year; **peduncles** 2-3 mm long, covered with 10-14 scale-like, opposite, decussate, appressed, imbricate, ovate, concave leaves; **sterile scales** 2-4; **fertile female cone scales** usually 6; **ovules** 2, vase-shaped with truncate apices, often not fully developing into seeds; **seeds** (1-) 4 (-6) per cone, 3.5-4.5 mm long, about 2.5 mm wide, light to medium brown, roughened by the presence of many resin vesicles; **cotyledons** 2; **male cones** terminal on lateral branchlets, sessile, oblong to subglobose, 2.5-3.5 mm long, 1.5-2.0 mm wide, pale green, becoming brown; **male cone scales** 8, opposite, decussate, about 1.5 mm in diameter, those towards the apex smaller; **lamina** flabellate or ovate-deltoid, about 1.0 mm long, 1.5 mm wide, often with a cusp about 0.3 mm long at the apex; **microsporangia** 3-4 (-6), about 0.5 mm long; **leaves** dimorphic: **juvenile leaves** present in seedlings and to some extent on leading shoots of older plants, opposite, occasionally 3-whorled, divergent, linear-lanceolate or needle-like, 1.5-6.0 mm long, acuminate, with rigid, pungent tips, the bases long-decurrent, **adaxial surface** broadly keeled, covered by the broad, white, longitudinal band of about 4 rows of stomata on each side of the midrib at the base; **adult leaves** opposite, decussate, appressed, sessile, scale-like, narrowly to broadly ovate, broadly keeled, rolled or partially folded around the twig, 1.5-2.0 mm long, 1.0-1.5 mm wide, acute-cuspidate often apiculate or mucronate, green or sometimes blue-green, aromatic, with or without glands on the abaxial surface, becoming hardened and woody in the 3rd year, gradually flaking off in the 4th or 5th year, or falling earlier with the branchlet; **buds** naked, concealed by leaves; **branchlets** concealed by the crowded, imbricate leaves for the 1st three years, about 1 mm in diameter the 1st year, growing about 1 mm in diameter per year thereafter, dark gray or charcoal, occasionally blue-glaucous, roughened by hardened, persistent leaves that gradually fall off, eventually smooth, eventually mostly deciduous; **branches** slender, creeping and long-trailing, branchlets becoming erect or upcurved along one side of the branch; **crown** wide and flat, dense or open; **shrub** usually less than 0.5 meters tall; **root system** fibrous, spreading.

Infraspecific Variation and Hybridization: Creeping juniper is similar to *J. virginiana* except in growth habit, showing great variation in shapes and sizes of both the juvenile and adult leaves. The branches usually have a one-sided appearance, due to their trailing nature and this aspect also helps distinguish the species from *J. virginiana* when dealing with specimens, where the growth habit of the plant is not known. Hybridization with redcedar is known to occur in the northern part of the distribution range of *J. virginiana*.

Importance: More than 70 cultivars have been developed from this species, demonstrating its great value to horticulturalists. It is used as a planting on banks, stone walls, in rock gardens and as a ground cover.



3. *Juniperus virginiana* L.

Common Names: redcedar, eastern redcedar or eastern juniper, savin, red savin, Carolina-cedar, pencil-cedar, Virginia cedar, Virginia juniper, cedar-apple, redcedar juniper, *baton rouge* (redstick)

Type Description: Linnaeus, Species Pl. II, p. 1039, 1753

Synonyms: *J. caroliniana* Michx., *J. sabina* Hook., *Sabina virginiana* (L.) Antoine

Origin: Native to eastern North America

Habitats: Typically scattered individuals on loamy soils of sunny slopes, pastures and old fields, sometimes in swamps or on lake shores, but more often on dry, rocky, calcareous hillsides. Frequent on dry, poor soils of the valleys in eastern New York and on the coastal sands of Long Island. Common to infrequent in central and western New York on limestone soils of bluffs, gorges, ravines and alvar vegetation of the flatrock, old fields and pastures, but scarce in the Adirondacks. Often found in places not frequented by fire, growing vigorously on most soils in the Northeast, but New York populations do not compare with vigorous stands found on alluvial soils further south

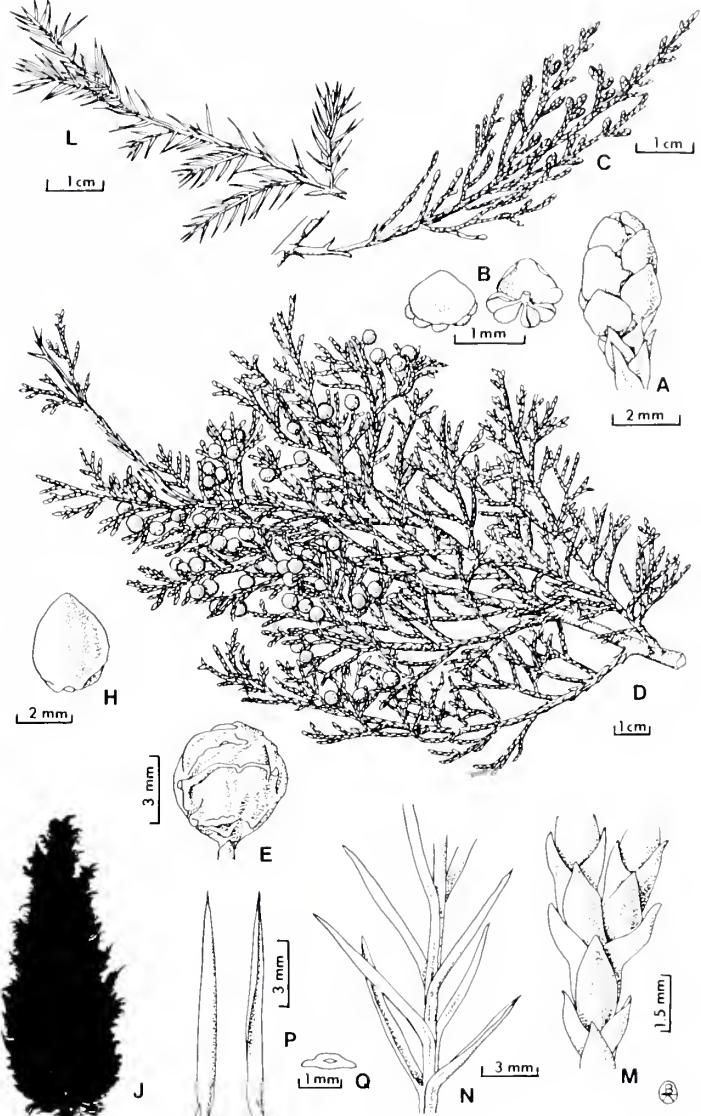
Habit: A small to medium-sized tree, the crown narrowly to broadly conical, frequently dense, becoming ragged or sculptured with age, trunks with fibrous, light, shredding bark and frequently buttressed at the base

Pollination: February-May

Mature Cones Opening: August-October of the 1st or 2nd year

General Distribution: Southern Maine west through southern parts of Ontario, Michigan, Wisconsin and Minnesota to southeastern South Dakota, south to Florida, Mississippi, northwestern Louisiana and eastern Texas; disjunct in northeastern South Dakota, southwestern North Dakota, northwestern Texas and central Wisconsin

Description: dioecious (infrequently monoecious); **female cones** borne on short, lateral branchlets or peduncles on the previous year's growth (less often on 2nd-year growth), erect, globose or subglobose, 3-6 (-8) mm in diameter, pale green when young, becoming deep purple or violet when mature, glaucous with a waxy, light blue or gray-blue bloom, fleshy, resinous, sweet, aromatic, persistent 1-2 years; **peduncles** 1-5 mm long, clothed by 8-10 scale-like leaves; **sterile scales** 2-4, at least 2 of them oblong with a shiny, yellow-brown apex; **fertile female cone scales** usually 6; **seeds** 1-2, acute and occasionally apiculate at the apex, light chestnut brown, lustrous, with a relatively small 2-lobed hilum; **cotyledons** 2; **male cones** oblong-cylindrical.



(2) 3-4 mm long, 1.5-2.0 mm wide, green when young, becoming greenish-brown to brown, the apex slightly narrowed; **male cone scales** (10) 12, arranged in decussate pairs on the cone axis, the apical 1 or 2 about half the size of the others; **lamina** orbicular or flabellate, 1.5 mm in diameter, light brown, glabrous; **microsporangia** (3) 4-5 (6), 0.6-0.8 mm long; **peduncle** naked, concealed by the leaves of the branchlets, about 0.7 mm long; **leaves** dimorphic, with juvenile leaves few, appearing on young seedlings and leading shoots of older plants, the transition to adult leaves either gradual or abrupt; **juvenile leaves** whorled or opposite and decussate, long-decurrent, covering the branchlets, subulate or linear-lanceolate, 4-9 mm long, long-acuminate, stiff, pungent, light yellow-green or blue-green, turning rusty, light purple or brown in winter, eglandular, hardening and becoming more rigid, then mostly disarticulating at the point of decurrence in the 4th to 7th year, the remaining bases gradually flaking off, **adaxial surface** concave, often flattened in seedlings or very young plants, bearing 4-5 rows of stomata on each side of the rather flat midrib, the stomata often not evident in young plants, **abaxial surface** convex or rounded-keeled, margins often slightly recurved, lacking stomata except on seedlings or very young plants, which have a flattened abaxial surface with up to 4 rows of stomata sunken on each side of the raised midrib; **adult leaves** opposite, decussate, sessile, crowded and appressed, thereby completely clothing the branchlet, scale-like, ovate, concave, 1.5-2.0 (-3.0) mm long, the exposed portion, 1.0-1.5 mm long, about 1 mm wide, acuminate acute or occasionally obtuse, the apex spreading (later becoming appressed and yellow) and keeled, more rigid than the flattened, sometimes depressed, the basal portion light green, glabrous, entire, aromatic, becoming hard, woody and brown in the 3rd year and finally falling either with the deciduous branchlets after 2-3 years or separately from persistent branchlets after 4-6 years, **abaxial surface** usually bearing a resin gland just below the middle; **buds** naked, minute, inconspicuous, covered by the leaves; **branchlets** horizontal or pendulous, completely covered in the 1st three years by the crowded, appressed scale-like adult leaves or by the decurrent bases of the juvenile leaves, terete, less than 1 mm in diameter the 1st year, to 6 mm in diameter by the 6th year, dark brown to purple or deep red-brown, becoming gray or blackened with age, mostly deciduous; **branches** ascending or spreading in young trees and upper crowns of mature trees, horizontal lower down, short, slender, thicker and heavier only with great age; **bark** thin, 4-7 mm thick, pale brown or red-brown, often grooved, shredding in long, narrow, fibrous strips; **crown** narrowly or broadly conical, dense, often breaking up and becoming ragged with age; **trunk** to 70 (-130) cm in diameter, frequently buttressed toward the base with age; **tree** 1-15 (30) m tall; **root system** deep, extremely windfirm ($2n = 22$).

Infraspecific Variation and Hybridization: In coastal or wind-swept situations, under severe environmental stress from salt or ice, redcedars sometimes grow only a few centimeters tall, with long branches forming broad, dense, prostrate mats. This species also shows considerable genetic variation across its eastern North American range, with several infraspecific categories having been described from regions outside New York. Morphological variation is evident in the diameter of branchlets, length, apex and shape of scale-like leaves, leaf terpene content, diameters and lengths of microstrobili, bark color, crown shape and degree to which the branches droop. A tendency towards shorter leaves, smaller cones, thicker ultimate branchlets, more cinnamon-colored bark, a rounder crown and a greater percentage of the terpene, germacrene D, in southeastern coastal populations separates var. *silicicola* (Small) M. Murray, along the Gulf and southern Atlantic coast (Adams, 1986). Intermediate individuals, showing characters of both *J. virginiana* and *J. scopulorum* Sarg. in the west and *J. virginiana* and *J. ashei* Buchholz in the southwestern part of the range of eastern redcedar are probably the result of hybridization and introgression (Fassett, 1944; Hall, 1952). However, there is some terpene evidence pertinent to *J. virginiana*, *J. scopulorum* and their hybrids (Flake et al., 1969) that suggests that intermediates have not been recently established. *Juniperus virginiana* and *J. horizontalis* may have been hybridizing for a long time (Fassett, 1944, 1945; Hall, 1952). More northern populations of *J. virginiana* tend to have characteristics that approach some of those of *J. horizontalis*, such as larger megastrobili, larger and diffently-shaped glands on scale-like leaves and greater numbers of megastrobili with curved peduncles. Variety *ambigens* Fassett, a trailing to semi-erect shrub, is reminiscent of *J. horizontalis* but shares characteristics with *J. virginiana* var. *virginiana* and var. *crebra* Fern. & Griseb. Mature trees of the latter variety tend to be more columnar, with rarely-drooping branchlets, less appressed, narrowly ovate, acute adult scale-like leaves and very shallowly pitted seeds.

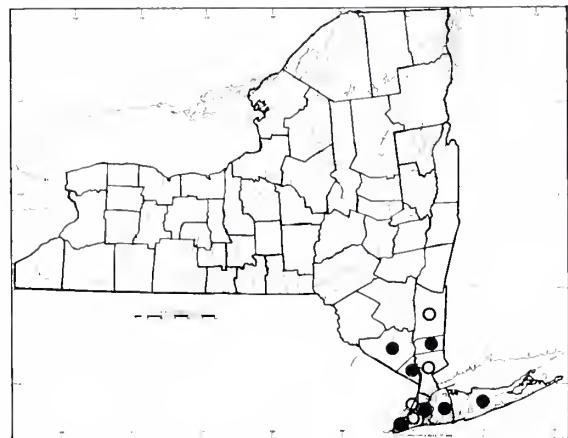
Importance: Some earlier uses for redcedar were boat-building, manufacture of shingles, fence posts, log cabins, pails, wood-ware, lining of chests for fragrance and insect protection. Extracts have been used in medicine and perfumes. The manufacture of pencils was economically the most important use, as well as the most destructive to mature trees. Only the straight-grained heartwood was used, and, with the exhaustion of its supply, redcedar was replaced in the industry by incense-cedar [*Calocedrus decumbens* (Torr.) Florin] of western North America. The decay-resistant, light, close-grained, brittle, weak, wood is aromatic, still used for fragrant chests and to produce oil-of-cedar (heartwood oil) for perfumes and components of soaps, polishes and cosmetics. The oil is also used in insecticides and in oil-immersion preparations for microscopes. Native Americans have used extracts of this plant extensively for an assortment of medicinal cures similar to those of *J. communis*, but also for treatment of muscular pains, cramps, mumps, dysentery, headaches, skin rash, arthritis and rheumatism, and as an antiseptic and insect repellent. The bark was used in making canoe parts, mats and dyes. Redcedar is sometimes selected as a Christmas tree, and at least 70 cultivated varieties have been developed to add variety to its frequent use in landscape plantings.

2. CHAMAECYPARIS

Common Names: false-cypress, white-cedar, cedar

Authority: Spach, Hist. Natur. Veget. Phan. XI, p. 329, 1842

Chamaecyparis is genus of seven species with a fairly narrow distribution in Asia and North America. It is closely related to *Cupressus*, from which it is distinguished by its five or fewer seeds per scale, smaller female cones, flattened branchlets and entire leaves. Peltate, globose cones maturing in the 1st year and smaller leaves with exposed connivent margins distinguish it from *Thuja*, and the dry, woody, mature female cones, growth habit and flattened branchlets easily separate it from *Juniperus*. Globose or pitted resin glands may be borne on the abaxial surface of the adult leaves, with both the lateral and facial leaves featuring grooves or depressions whether or not there are glands. Two species of *Chamaecyparis* have relatively limited ranges in northwestern North America. Port Orford-cedar, or Lawson-cypress, *C. lawsoniana* (A. Murr.) Parl., was once a valuable timber tree, but it is currently economically important for ornamental use, with nearly 300 cultivars in the nursery trade. Nootka-cypress or Alaska-cedar [*C. nootkatensis* (D. Don) Spach] was also harvested for timber, and a few horticultural varieties have been developed for the garden. One species, Atlantic white-cedar [*C. thyoides* (L.) BSP.] is a native of eastern North America.



1. *Chamaecyparis thyoides* (L.) BSP.

Common Names: Atlantic white-cedar, southern white-cedar, swamp-cedar, coastal white-cedar, coast-cedar

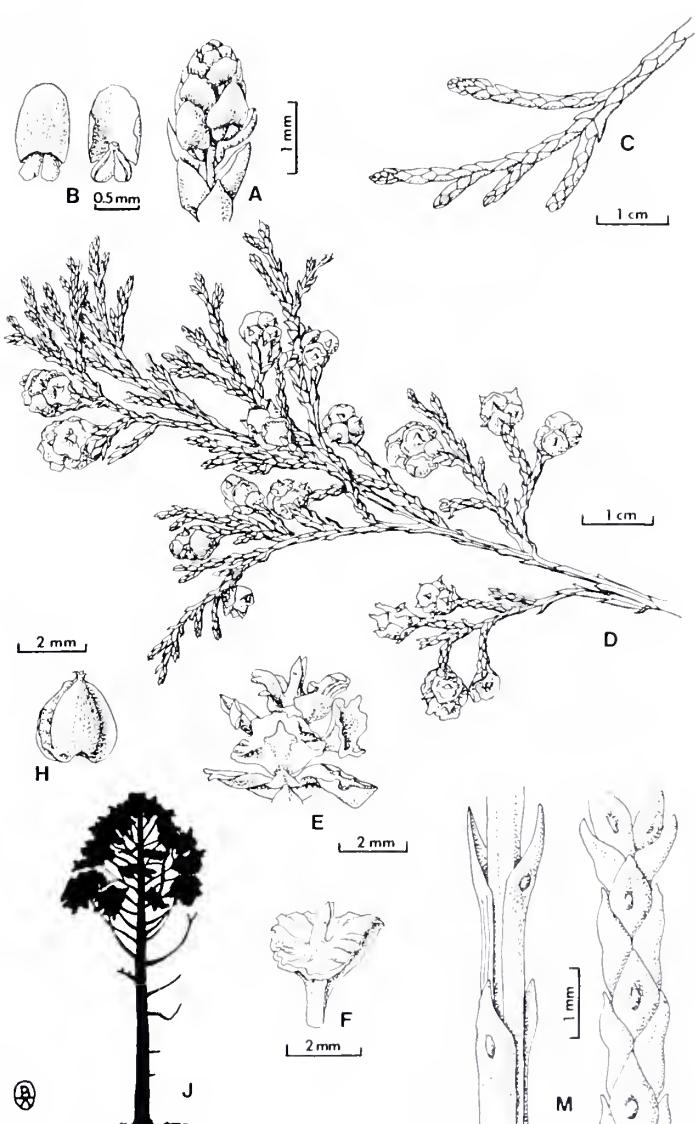
Type Description: Linnaeus, Species Pl. II, p. 1003, 1753

Synonyms: *Chamaecyparis sphaeroidea* Spach, *Cupressus thyoides* L.

Origin: Native to the eastern, temperate Coastal Plain of the United States

Habitats: Cool, wet swamps and bogs, withstanding long periods of inundation; in pure stands in the northern part of its range, mixed with baldcypress in the southern United States. Of limited distribution in New York, found only in swamps and pine barrens where major stands occur in the southeastern part of the State, especially in the lower Hudson Valley and on Long Island, where it forms "cedar swamps" similar to those in the pine barrens of New Jersey

Habit: Small to large tree with slender ascending, spreading or horizontal branches, forming a narrow conical, often spire-like crown, usually clothed to the ground with live branches, even in the densest forest conditions, the branches eventually dying and deciduous on older trees



Pollination: March-April

Mature Cones Opening: September-October of the 1st season

General Distribution: Along the Atlantic coast from southern Maine to northern South Carolina and western Florida, west along the Gulf of Mexico to eastern Louisiana; disjunct in central South Carolina and eastern Florida

Description: **monoecious;** **female cones** solitary, occasionally paired, with only 1 cone fully developing, terminal on short branchlets with scale-like leaves, erect, globose, (3.5-) 5-6 mm in diameter, glabrous, glaucous-blue, dark brown or dark red to purple-brown beneath the bloom, persistent into the 2nd year; **sterile scales** 2, lanceolate, ovate or oblong with a swollen, green apex; **fertile female cone scales** 6, opposite or alternate, peltate, glabrous, apical portion orbicular to flabellate, 3-4 mm in diameter, bluc, becoming dark red-brown to purple-brown, the apical mucro prominent, broadly triangular, 0.8-1.0 mm long, acute, yellow-brown; **ovules** 2 per scale, usually only 1 developing into a seed; **seeds** 6, oblong to ovoid, slightly compressed, 2.0-2.5 mm long, 1.5-2.0 mm wide, emarginate or acute, rounded at the base, dark red-brown, dark brown or black, winged on each side, **wings** 2, relatively thick towards the seed, thin at the margins, about 0.5 mm wide, or about half as wide as the seed, dark red-brown; **cotyledons** 2; **male cones** solitary, terminal on short lateral branchlets with scale-like leaves, oblong-cylindric to subglobose, about 2 mm long and 1 mm wide, light brown to brown, deciduous by the 2nd year; **sterile scales** lacking; **peduncle** naked, concealed by the overlapping leaves of the branchlet; **male cone scales** (8-) 10 (-12), opposite, decussate; **lamina** orbicular-flabellate to ovate, about 1 mm in diameter, entire, glabrous; **stalk** about 0.2 mm long; **microsporangia** 2-4, attached adaxially, about 0.3 mm long; **juvenile leaves** present only on seedlings, linear-lanceolate, 4-8 mm long, 1.0-1.5 mm wide, acute, green, glabrous, entire, with 8-10 rows of stomata on each side of the midrib on the abaxial surface, persistent usually 3-4 years; **adult leaves** opposite, decussate, crowded, appressed, scale-like, imbricate, ovate, broadly keeled, adaxially concave, 1-2 mm long, 0.8-1.3 mm wide, acute, glabrous, entire, the margins of opposing lateral leaves meeting below and sometimes connivent above the apex of the facial leaf, aromatic, yellow-green at 1st, becoming dull dark green the first year, turning dark brown, the stomata arranged in 15-20 short, longitudinal rows at the base on each side of the abaxial surface and partially hidden by the overlapping leaves from below, mostly falling with the branchlets in the 2nd year; **leaves of persistent branchlets** attaining lengths of 7 mm including the long, decurrent, appressed base, often with large, prominent, puffy resin glands, these particularly noticeable on the leaf immediately subtending the lateral branchlet, hardening, becoming woody, dark brown or gray-black by the end of the 3rd year, finally separating from the branchlet in the 4th year; **lateral leaves** strongly keeled on the abaxial surface for the length of the leaf, lacking glands; **facial leaves** more flattened, slightly to sharply keeled towards the apex, bending outward and spreading from the middle, with a spherical to elliptical resin gland near the middle of the abaxial surface; **buds** very small, inconspicuous, lacking scales, usually covered by closely overlapping leaves; **branchlets** only slightly flattened, more so on young plants, but together arranged in fan-like, flattened clusters, dull green the first year, brown to gray the 2nd year, dark brown or black-gray the 3rd year, very dark or black thereafter, many lateral branchlets deciduous after the 2nd year, the persistent branchlets roughened from flaking leaves and from scars of the deciduous branchlets in the 3rd year, later becoming smooth except for prominent, raised branchlet scars; **branches** slender, long and ascending, with pendulous lateral branchlets in the upper crown, shortened and more horizontal lower on the tree, persistent, the secondary branches twisted, appearing almost gnarled, dark gray or black; **bark** thin, to 2 cm thick on older trees, red-brown, fissured into flat connected ridges, the ridges often twisting spirally around the trunk, flaking off in long fibrous strips; **crown** narrowly conical, often spire-like, with slender, ascending, spreading or horizontal branches; **trunk** 70-130 cm in diameter, smaller farther north, usually clothed to the ground with live branches, even in dense forest conditions, the branches eventually dying, deciduous on older trees; **tree** 10-25 m tall; **root system** wide-spreading ($2n = 22$).

Infraspecific Variation: One botanical variety has been described, and a few cultivars have been developed. Vegetative characters, such as presence or absence of foliar resin glands, provide the limited variation within the species. *Chamaecyparis thyoides* var. *henryae* (Li) Little has been described from Florida and Alabama, with glands only on leaves of the main axes or branchlets. Twisting of the bark on the main trunk of trees is variable, and may not be reliable in distinguishing varieties (Godfrey, 1988).

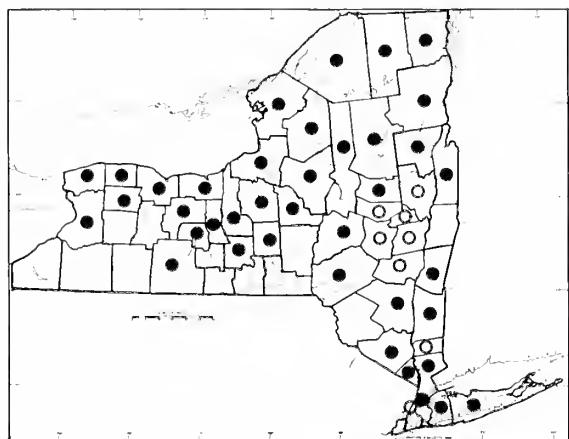
Importance: This tree is of little current economic importance because of its relative scarcity. The light, decay-resistant, insect-repellant qualities of the wood made Atlantic white-cedar useful in the past for telegraph and telephone poles, ice cream packing tubs, shingles, siding, flooring, fence posts, log cabins, railroad ties, piles, piers, boats and wooden tanks. In earlier times the wood was used for water storage for cities and ocean-going vessels, because certain chemical properties inhibited growth of microorganisms. Demand continued for these useful products long after nearly all large, living white-cedars had been harvested, so rot-resistant, durable, preserved logs were then pulled up from the depths of the swamps. The straight, close-grained, uniform-textured wood has a slight fragrance, an ability to hold paint well and not warp or shrink. These are the desirable qualities, while softness and weakness of the wood are obvious disadvantages. The tree is not popular as an ornamental, and only a few cultivated varieties have been developed.

3. THUJA

Common Names: arborvitae, cedar

Authority: Linnaeus, Species Pl. II, p. 1002, 1753

A genus of five species with three native to eastern Asia, one (the economically important *T. plicata* Donn ex D. Don) native to western North America and one (*T. occidentalis*) native to eastern North America. *Thuja plicata* has been lumbered for its valuable, durable wood for telephone poles, shingles and siding. *Thuja occidentalis*, which was originally harvested for these products, is one of the most widely planted ornamental conifers, from hedges to specimen trees to dwarf varieties. Distinctive features of this short-branched tree are thick, short, decussate leaves with exposed margins not meeting, woody, imbricate cones with few scales, and foliage in flattened, feathery sprays.



1. *Thuja occidentalis* L.

Common Names: northern white-cedar, arborvitae, American arborvitae, cedar, eastern arborvitae, white- cedar, swamp-cedar

Type Description: Linnaeus, Species Pl. II, p. 1002, 1753

Origin: A native of North America

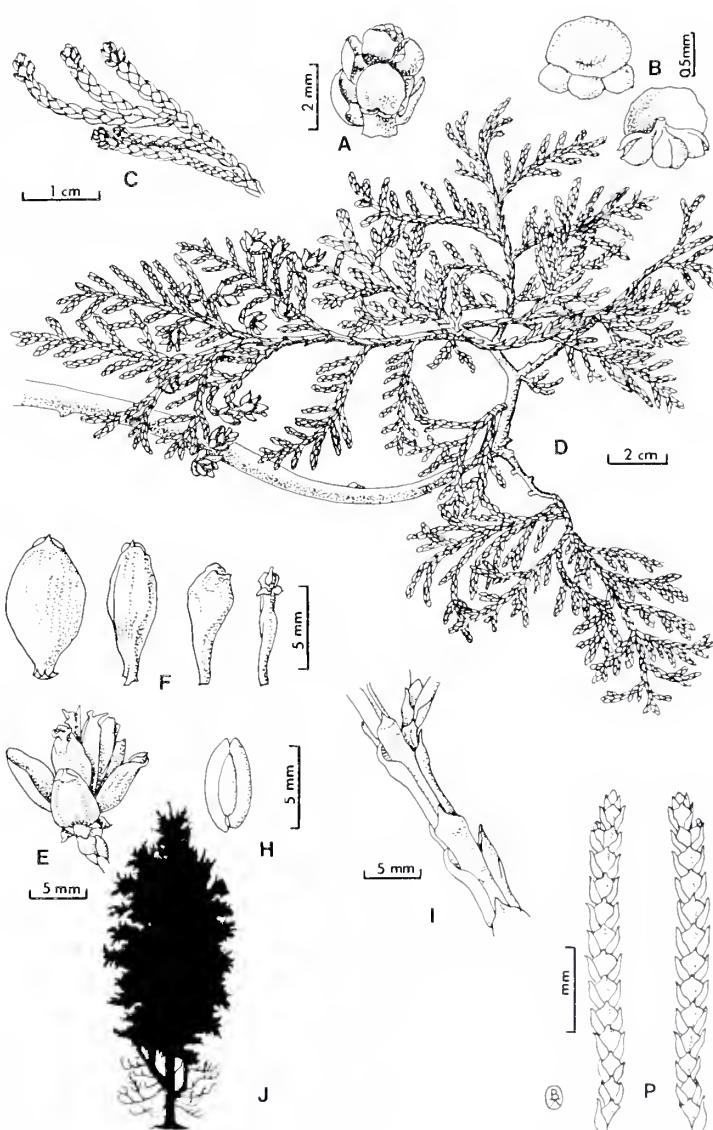
Habitats: Usually low moist sites such as swamps, stream courses, borders of ponds and lakes, where it often forms almost impenetrable, pure stands. Sometimes growing on higher, drier ground, but usually thriving on mucky soils near limestone outcroppings. Common in dense stands in swamps and bog margins of northeastern and eastern New York State, less common on drier ground in the Adirondacks, and rare on the Allegheny Plateau

Habit: Medium-sized tree with a narrow, compact, conical crown and stout, buttressed trunk that is often multiple, with 2 or 3 main axes, the short, horizontal branches soon ascending, branchlets in flattened, pendulous, ascending or horizontal sprays

Pollination: April-May

Mature Cones Opening: July-September of the 1st season

General Distribution: Nova Scotia west to southeastern Manitoba, south to southeastern New York, eastern Pennsylvania, Ohio, Michigan, northwestern Indiana, northern Illinois and south in the Appalachians to western North Carolina and eastern Tennessee



Description: monoecious; **female cones** terminal on short lateral branchlets or peduncles, ovoid to short-oblong, (8-) 12 (-15) mm long, 4-6 mm wide and closed when young, to 10 mm wide when open and spreading, green to purple or pink at pollination, becoming red-brown to light brown later darkening, maturing the 1st season, deciduous after the 2nd year; **peduncles** 2-5 (-11) mm long, clothed by (6) 8-10 (12) scale-like, opposite, decussate, imbricate, appressed, ovate, concave leaves; **female cone scales** 8, opposite, decussate, imbricate, woody when mature, red-brown to brown, glabrous or often minutely puberulent at the apex and upper margins, each scale separating slightly at the apex, exposing an inner, rounded or obtuse fold and an outer, hardened dark brown to black mucro, the upper pair of scales sterile, oblong, 7-9 mm long, 2 mm wide, usually not separating or becoming fully developed, the 4 middle scales fertile, ovate to ovate-lanceolate or nearly oblong, concave, 7-9 mm long, 3-5 mm wide, the basal pair sterile, ovate, 3-6 mm long, 2.5-3.0 mm wide; **seeds** 8, borne in pairs at the base of the scale, oblong, 3-5 mm long, 2.5-3.0 mm wide, appearing notched at the apex due to projecting wings on either side of the seed, dark brown, with 4 longitudinal oil vesicles running from 1/4 to the full length of the seed, these projecting above each side of the seed body, **wings** 2, longer than the seed and as wide, pale brown, membranous, occasionally minutely puberulent on the upper margins; **cotyledons** 2; **male cones** terminal on lateral branches that are 1-15 mm long, globose to subglobose or short-oblong, inconspicuous, 1.5-2.5 mm long, 1.0-1.5 mm wide, green when young, quickly turning brown then gray-brown, often persisting into the next year; **peduncle** 0.5-1.0 mm long, mostly concealed by leaves at the end of the branchlet; **sterile scales** lacking; **male cone scales** 8, the apical pair often undeveloped, peltate, yellow-brown to light brown; **stalk** about 0.3 mm long; **lamina** flabellate, 0.8-1.0 mm long, about 1.2 mm wide, rounded at the apex, glabrous, entire; **microsporangia** 2-4, attached where the stalk and lamina meet, about 0.5 mm long; **juvenile leaves** present only on young seedlings, awl-shaped or linear; **adult leaves** opposite, decussate, imbricate, scale-like, completely covering the branchlets, flattened facially (facial leaves) or bilaterally (lateral leaves), appressed except for the slightly spreading, free apex, 2.0-3.8 mm long on younger branchlets (to 5 mm on older branchlets, 6.5 mm on leading or rapidly-elongating shoots), about 1.5 mm wide, cuspidate (acuminate on leading or rapidly elongating shoots), glabrous, bright, shining green on the upper surface of the spray, pale or dull yellow-green on the lower surface, aromatic; **facial leaves** usually bearing an obscure, swollen resin gland near the apex of the abaxial surface; **lateral leaves** sharply keeled, eglandular, the upper, exposed margins spreading, not meeting; **buds** naked, minute, yellow, covered by the closely appressed scale-like leaves of the branchlet; **branchlets** flattened, arranged in fan-like clusters or sprays, completely clothed by the green, decurrent bases of the leaves, turning light cinnamon-red with the death and browning of the leaves during their 2nd season, the short, pendulous, lateral branchlets mostly deciduous after the 2nd year; **persistent branchlets** gradually becoming terete and abruptly enlarged at the base, ultimately covered with smooth, lustrous dark orange-brown bark with conspicuous scars left by deciduous lateral branchlets; **branches** short, stout, horizontal, or ascending; **bark** thin, 6-9 mm thick, red-brown, fibrous, shallowly fissured, the anastomosing ridges covered with elongated scales; **crown** conical, narrow, compact, the short horizontal branches soon ascending, with flattened, pendulous, ascending or horizontal, flattened sprays or lateral branchlets; **trunk** buttressed, stout, 35-75 (-100) cm in diameter, sometimes twisted, sometimes divided into 2 or 3 stems; **tree** to 20 m tall, relatively short-lived; **root system** shallowly wide-spreading, the large lateral roots often exposed near the buttressed base of older trees ($2n = 22$).

Importance: The most important use of arborvitae is as a cultivated ornamental. One of the most frequently cultivated native trees, it is used as a windbreak, next to buildings and for specimen trees. Over 200 cultivated varieties, many of them dwarf, are in the nursery trade. The decay-resistant, fragrant, light, weak, brittle wood has been utilized for fence posts, shingles, rails, railroad ties and poles. Cedar oil extract of arborvitae is used medicinally as a stimulant for heart and uterine muscles and as an irritant and antiseptic. The high concentration of vitamin C in the oil of the leaves and bark cured scurvy in early explorers. The special characteristic of separating along growth rings when pounded made the tree useful for splints in the construction of canoes by Native Americans and early pioneers. The dry shredding outer bark was a favorite source of tinder and native Americans used the twigs as brooms and the wood for bows, baskets, hats and roofings. Native Americans used this species for a variety of ailments, especially respiratory, but also heart and chest pains, gout, rheumatism, dropsy and treatment for worms and warts. The twigs and foliage provide browse for large mammals and the seeds are a food source for birds and small mammals.

APPENDIX

FUNGI ASSOCIATED WITH PLANT SPECIES IN THIS TREATMENT

by J. Kenneth Dean

To be included in this list, a fungus must occur on a host species in this treatment, somewhere in the United States. Abbreviations of state names indicate literature citations only. A single asterisk (*) indicates that the fungus occurs in New York State, and is known to associate (elsewhere) with a host treated here. A double asterisk (**) indicates that a NY specimen with host information has been seen.

OOMYCETES

Phytophthora cinnamomi Rands, on *Abies balsamea* (N.C.), on *Picea abies* (southeastern states, Md., N.C., Va.), on *Pinus resinosa* (Southeastern states, Del., Md.), on *Pinus strobus* (Md., N.C.), on *Pinus sylvestris* (Southeastern states, Md., Va.), *Tsuga canadensis* (N.C.)

Pythium irregularare Buisman, on *Pinus resinosa* (Wisc.)

Pythium ultimum Trow, on *Pinus resinosa* (widespread), on *Pinus strobus* (widespread)

OPHIOSTOMATALES

Ceratocystis coerulescens (Muench) Bakshi, on *Picea glauca* (Ark.), on *Pinus banksiana* (Minn.), on *Pinus resinosa* (Minn.)
Ceratocystis piceaperda (Rumbold) Moreau, on *Picea glauca* (Ark.)

Ceratocystis seticollis R.W. Davidson, associated with bark beetles in *Tsuga canadensis* (N.Y.)

Ophiostoma distortum (R.W. Davidson) De Hoog & Scheffer, on wood, associated with bark beetles, on *Abies balsamea* (N.Y.)

Ophiostoma huntii (Robinson-Jeffrey) De Hoog & Scheffer, on *Pinus strobus* (N.Y.)

Ophiostoma ips (Rumbold) Nannf., on *Picea glauca* (Ark.), on *Pinus banksiana* (Minn.), on *Pinus resinosa* (Minn., Pa.), on *Pinus rigida* (N.J.), on *Pinus strobus* (N.Y.), on *Pinus sylvestris* (Mass.)

Ophiostoma minus (Hedg.) Syd. & P. Syd., on *Pinus banksiana* (N.C., Va.), on *Pinus resinosa* (N.C., Va.), on *Pinus rigida* (N.C., Va.)

Ophiostoma nigrocarpum (R.W. Davidson) De Hoog, on logs of *Tsuga canadensis* (N.H.)

Ophiostoma olivaceum Mathiesen, on *Picea glauca* (Ark.)

Ophiostoma piliferum (Fr.:Fr.) Syd. & P. Syd., on *Pinus banksiana* (Minn.), on *Pinus rigida* (Pa.), on *Pinus strobus* (Minn.)

Ophiostoma sparsum (R.W. Davidson) De Hoog, on *Picea glauca* (Ark.)

Ophiostoma stenoceras (Robak) Melin & Nannf., on *Pinus strobus* (N.H., N.Y.)

DIAPORTHALES

Cryptosporella thujina Nag Rag & DiCosmo, on *Chamaecyparis thyoides* (N.Y.), on *Juniperus virginiana* (Tex.)

Eutypella leprosa (Pers.:Fr.) Berl., on *Pinus strobus* (Iowa)

Leucostoma kunzei (Fr.:Fr.) Munk, on twigs and stems of *Abies balsamea* (Mich.)

Valsa abietis (Fr.:Fr.) Fr., branch canker of *Abies balsamea* (Maine, Pa.), on dead limbs of *Larix laricina* (N.Y.), of *Tsuga canadensis* (Va., W.Va.)

Valsa ambiens (Pers.:Fr.) Fr., on *Larix laricina* (Mich.)

Valsa cenisia De Not., on dead limbs of *Juniperus virginiana* (Del., Mich., N.J., Okla.)

Valsa collicula (M. Wormsk.) Cooke, on limbs and twigs of *Pinus strobus* (N.Y., Pa.), on *Pinus sylvestris* (Pa.)

Valsa friesii (Duby) Fkl., on *Juniperus virginiana* (S.C.)

Valsa pini (Albertini & Schw.) Fr., on *Pinus resinosa* (Iowa), on *Pinus strobus* (widespread), on *Pinus sylvestris* (Iowa), on *Pinus virginiana* (Va.)

SORDARIALES

Bertia moriformis (Tode:Fr.) De Not. var. *latispora* Corlett & J. Krug, on *Abies balsamea* (N.H.), on *Pinus strobus* (N.H.),
Tsuga canadensis (N.H., N.Y.)
Nitschikia broomeiana (Berk.) Nannf., on *Pinus strobus* (Ga.)

PEZIZALES

Pithya cupressina (Pers.) Fkl., on dead foliage of *Chamaecyparis thyoides* (N.J., N.Y.), on *Juniperus virginiana* (Maryland,
Mass., N.C., Okla., Va.)
Plectania melastoma (Sowerby) Fkl., on *Juniperus virginiana* (N.C.)
Plectania nanufeldtii Korf, on *Juniperus virginiana* (N.C.)
Rhizina undulata (Fr.) Fr., seedling blight, on *Picea rubens* (Vt.), on *Pinus banksiana* (Minn.), on *Pinus resinosa* (Md.), on
Tsuga canadensis (N.Y.)
Scutellinia scutellata (L.:Fr.) Lambotte, on wood of *Tsuga canadensis* (N.C., N.Y.)

AMPHISPHAERIALES

Physalospora abdita (Berk. & Curtis) N. Stevens in Voorhees, on dead limbs of *Juniperus virginiana* (Ga., La.)

LEOTIALES

Ascocalyx abietina (Lagerberg) Schlaepfer, on *Pinus banksiana* (Mich., Minn., N.Y., Wisc.), on *Pinus resinosa* (Maine, Mich.,
Minn., N.H., N.Y., Wisc.), on *Pinus strobus* (N.Y., Vt.)
Atropellis pinicola Zeller & Goodd., on *Pinus strobus* (Oreg.)
Atropellis piniphila (Weir) Lohman & Cash, on *Pinus banksiana* (S.D.)
Atropellis tingens Lohman & Cash, on *Pinus banksiana* (N.C., Pa.), on *Pinus resinosa* (N.C., Pa., Va.), on *Pinus strobus* (Va.),
on *Pinus sylvestris* (Ohio), on *Pinus virginiana* (Ga.)
Botryotinia fuckeliana (de Bary) Whetzel, on *Picea abies* (N.C.)
Cenangium acicola (Fkl.) Rehm, on *Pinus resinosa* (Ohio), on *Pinus strobus* (Wisc.)
Cenangium atropurpureum Cash & Davidson, on *Pinus rigida* (Md.), on *Pinus sylvestris* (Pa.), on *Pinus virginiana* (Md.)
Cenangium ferruginosum Fr.:Fr., twig blight on *Abies balsamea* (Mich., Pa.), on *Pinus resinosa* (N.Y., Pa.), on *Pinus strobus*
(northeastern states, N.Y.), on *Pinus sylvestris* (N.Y., Pa.), on *Pinus virginiana* (Md., Va.)
Chloroscypha cedrina (Cooke) Seaver, on foliage of *Juniperus virginiana* (N.C., N.Y.)
Dasyscyphus ellisianus (Rehm) Sacc., on twigs of *Larix laricina* (N.Y., R.I.), on *Pinus resinosa* (northeastern states), on *Pinus*
rigida (eastern states), on *Pinus strobus* (eastern states), on *Pinus sylvestris* (Mass., N.J., Pa., R.I.), on *Pinus virginiana*
(Md., Pa., Va.)
Dasyscyphus oblongosporus Hahn & Ayers, on dead limbs of *Larix laricina* (Maine, Mass., Mich., N.Y.)
Dermea balsamea (Peck) Seaver in B.O. Dodge, canker on *Tsuga canadensis* (Ga., Mass.)
Didymascella chamaecyparidis (J.F. Adams) Maire, on foliage of *Chamaecyparis thyoides* (N.J.)
Discolhainesia oenotherae (Cooke & Ellis) Nannf., on twigs of *Pinus virginiana* (Va.)
Fabrella tsugae (Farl.) Kirschst., on *Tsuga canadensis* (Mass., N.C., N.H., N.Y., Pa., Wisc.)
Hemiphacidium planum (J.J. Davis) Korf, on *Pinus strobus* (Wisc.)
Hyaloscypha stevensonii (Berk. & Broome) Nannf., on *Pinus strobus* (N.Y.)
Korbia tsugae (Cash & R.W. Davidson) Reid & Cain, needle yellowing of *Tsuga canadensis* (N.C.)
Lachnellula abietis (Karst.) Dennis, on *Picea* sp. (N.Y., Vt.)
Lachnellula agassizii (Berk. & Curtis) Dennis, on wood of *Abies balsamea* (Maine, Mich., Vt.), on *Picea mariana* (Mich.,
N.Y.), on *Picea rubens* (N.Y., Vt.), on *Pinus strobus* (northeastern and north central states), on *Tsuga canadensis* (N.Y.)
Lachnellula arida (Phill.) Dennis, on wood of *Abies balsamea* (Mich.)
Lachnellula laricis (Cooke) Dharne, on dead limbs of *Larix laricina* (Vt.)
Lachnellula occidentalis (Hahn & Ayers) Dharne, on dead limbs of *Larix laricina* (Ark., N.Y., Pa., Vt.)
Lachnellula resinaria (Cooke & Phill.) Rehm, on *Abies balsamea* (Minn.)
Lachnellula subtilissima (Cooke) Dennis, on bark of *Abies balsamea* (Maine), on dead limbs of *Larix laricina* (Conn., Vt.), on
Picea mariana (Mich., N.Y.), on *Pinus sylvestris* (Mass.)
Lachnellula willkommii (R. Hartig) Dennis, canker on *Larix laricina* (Maine)

Mollisia fumigata (Ellis & Everh.) Sacc., on *Tsuga canadensis* (N.J.)
Nothophaeidium abietinellum (Dearn.) J. Reid & Cain, needle blight of *Abies balsamea* (N.H., N.Y.)
Orbilia xanthostigma (Fr.) Fr., on *Tsuga canadensis* (N.Y.)
Pezicula livida (Berk. & Broome) Rehm, on *Pinus strobus* (Ga., Iowa, Mass., N.C.)
Pezizella minutula Dearn., on needles of *Pinus rigida* (N.C.), of *Pinus virginiana* (N.C.)
Phacidium coniferarum (Hahn) DiCosmo, Nag Rag & Kendrick, on *Pinus strobus* (Maine)
Phacidium infestans Karst., snow blight, on *Abies balsamea* (New England states), on *Picea glauca* (New England states), on *Picea rubens* (New England states), on *Pinus strobus* (northeastern states)
Pragmopora pithya (Fr.) Groves, on *Pinus strobus* (N.Y.)
Sarcotrochila balsameae (J.J. Davis) Korf, needle cast of *Abies balsamea* (New England states, Wisc.)
Sarcotrochila piniperda (Rehm) Korf, on needles and twigs on *Picea* sp. (N.H., Vt., Wisc.)
Tryblidiopsis pinastri (Pers.:Fr.) Karst., on *Abies balsamea* (New England states), on *Picea glauca* (N.H.), on *Pinus strobus* (northeastern states, Pa.)
Tympinis confusa Nyl., on *Pinus strobus* (Conn., N.Y.), on *Pinus virginiana* (Va.)
Tympinis hypopodia Nyl., on blister rust cankers on *Pinus strobus* (Conn., Mass.)
Tympinis laricina (Fkl.) Sacc., on *Abies balsamea* (Maine, N.H., N.Y.), on *Pinus* sp. (N.Y.)
Tympinis neopithya Quellette & Pirozynski, on *Pinus* sp. (Mich., N.C.)
Tympinis truncatula (Pers.:Fr.) Rehm, on limbs of *Abies balsamea* (Mich., N.H., N.Y.)

RHYTISMATALES

Bifusella linearis (Peck) Hoehn., on *Pinus strobus* (Widespread)
Coccomyces petersii (Berk. & Curtis) M.A. Sherwood, on bark and twigs of *Juniperus communis* (Ala.), of *Juniperus virginiana* (Ala., Ga., Mass., N.C., N.Y.)
Coccomyces strobi J. Reid & Cain, on *Pinus strobus* (Conn., Mass., Minn., N.C., N.H., N.J., N.Y., Wisc.)
Cyclaneusma minus (Butin) DiCosmo, Peredo & Minter, on *Pinus sylvestris* (Mass.)
Cyclaneusma niveum (Pers.:Fr.) DiCosmo, Peredo & Minter, on *Pinus sylvestris* (Ga., Mass., Mich., Pa., Wisc.)
Davisomycelia ampla (J.J. Davis) Darker, on *Pinus banksiana* Great Lakes states)
Isthmiella fauldhii (Darker) Darker, needle cast on *Abies balsamea* (Maine, Mich., N.H., N.Y., Vt., Wisc.)
Lirula macrospora (R. Hartig) Darker, needle blight, tar spot, on *Picea glauca* (Ark., N.D.), on *Picea mariana* (Ark.) on *Picea rubens* (N.Y., Vt.)
Lirula mirabilis (Darker) Darker, needle cast of *Abies balsamea* (Mich., Wisc.)
Lirula nervata (Darker) Darker, needle cast of *Abies balsamea* (Maine, N.H., Vt.)
Lophodermium durilabrum Darker, on *Pinus strobus* (Wisc.)
Lophodermium juniperinum (Fr.) De Not. f. *cupressi-thyoidis* Sacc., on foliage of *Chamaecyparis thyoides* (N.J.), on *Juniperus communis* (widespread), on *Juniperus virginiana* (Mass., N.Y., Wash., Wisc.)
Lophiodermium lacerum Darker, secondary needle cast of *Abies balsamea* (N.H., N.Y., Pa., Vt.)
Lophodermium nitens Darker, on *Pinus strobus* (eastern states, Ga., Mich., N.C., Wash., Wisc.)
Lophodermium piceae (Fkl.) Hoehn., needle cast, tar spot, on *Picea abies* (Mass., Mich.), on *Picea glauca* (Mich.), on *Picea mariana* (Maine)
Lophodermium pinastri (Schrad.:Fr.) Chev., on *Pinus banksiana* (Great Lakes states, Idaho), on *Pinus resinosa* (widespread), on *Pinus rigida* (widespread), on *Pinus strobus* (widespread), on *Pinus sylvestris* (widespread), on *Pinus virginiana* (Ga., Md., Pa., Va.)
Lophodermium staleyi Minter, on *Pinus sylvestris* (Oreg.)
Lophodermium sediticolum Minter, Staley & Millar, on *Pinus resinosa* (Ind., Mich., Oreg., Wash.), on *Pinus virginiana* (Ind., Mich., Oreg., Wash.)
Lophomerum autumnale (Darker) Magasi in Quellette & Magasi, needle cast of *Abies balsamea* (Mich.)
Meloderma desmazieresii (Duby) Darker, on *Pinus resinosa* (N.Y.), on *Pinus rigida* (northeastern states, N.Y.), on *Pinus strobus* (eastern states, Ga., N.C., Wisc.)
Naemacyclus fimbriatus (Schw.) DiCosmo, Peredo & Minter, on cone scales of *Pinus resinosa* (Mass.)
Ploioderma hedgecockii (Dearn.) Darker, on *Pinus rigida* (N.C.), on *Pinus virginiana* (southeastern states, Miss., Tenn.)
Ploioderma lethale (Dearn.) Darker, on *Pinus resinosa* (N.Y.), on *Pinus rigida* (eastern states, Miss., Pa., W.Va., on *Pinus virginiana* (southeastern states, Tenn., Va.)
Propolis leonis (Tul. & C. Tul.) Rehm, on bark and cones of *Pinus sylvestris* (Ga.)
Propolis rhodoeca (Sommerf.) Fr., on *Pinus strobus* (Ga.)

Therrya fuckelii (Rehm) Kujala, on dead limbs of *Pinus resinosa* (Mich., N.H.)

Therrya pini (Albertini & Schw.) Hoehn., on limbs and twigs of *Pinus strobus* (eastern states, Ga., Mich.)

DIATRYPALES

Diatrypella favacea (Fr.:Fr.) De Not, on *Juniperus virginiana* (Ga.)

XYLARIALES

Rosellinia herpotrichioides Hepting & R.W. Davidson, needle and twig blight of *Tsuga canadensis* (N.C.)

Rosellinia deerata (Curtis & Ellis) Sacc., on wood of *Juniperus virginiana* (N.J.)

Xylaria cornu-damae (Schw.) Fr., on *Pinus strobus* (N.C.)

Xylaria curta Fr., on wood of *Tsuga canadensis* (Maine)

Xylaria hypoxylon (L.:Fr.) Grev., on wood of *Tsuga canadensis* (N.C., S.C.)

Xylaria longipes Nitschke, on logs of *Tsuga canadensis* (N.C.)

CORYNELIALES

Caliciopsis thujina (Ellis & Everh.) Fitzp., on dead foliage of *Chamaecyparis thyoides* (N.J.)

Caliciopsis nigra (Schrad.:Fr.) Fitzp., on limbs associated with galls on *Juniperus virginiana* (N.Y.)

Caliciopsis pinea Peck, on *Pinus rigida* (N.C., N.J.), on *Pinus strobus* (N.C., N.Y.), on *Pinus virginiana* (N.C., Va.), *Tsuga canadensis* (Pa.)

HYPOCREALES

Hypocrea ceramica Ellis & Everh., on *Juniperus virginiana* (N.C.)

Nectria fuckeliana Booth, on bark of *Abies balsamea* (Maine, Mich.)

Nectria thujana (Rehm) Sacc., on dead foliage of *Chamaecyparis thyoides* (N.J.)

Nectria truncata Ellis, on dead bark of *Chamaecyparis thyoides* (N.J.)

Scoleconectria cucurbitula (Tode:Fr.) C. Booth, canker on *Abies balsamea* (widespread), on *Picea mariana* (N.Y.), on *Pinus banksiana* (Wisc.), on *Pinus resinosa* (Wisc.), on *Pinus rigida* (N.J.), on *Pinus sylvestris* (Iowa), on *Pinus virginiana* (Md., Va.)

Thyronectria balsamea (Cooke & Peck) Seeler, bark canker on *Abies balsamea* (Mich., Minn., N.H., N.Y., Pa., Vt.), on *Pinus strobus* (N.Y.)

TRICHOSPHAERIALES

Trichosphaeria cupressina Syd., on dead foliage of *Chamaecyparis thyoides* (N.J.)

Chaetosphaeria parvicerca (Cooke) Sacc., on *Juniperus virginiana* (Ga.)

DOTHIDEALES

Asterina cupressina (Rehm) Cooke, on foliage of *Juniperus communis* (Wisc.)

Asterina sp., on needles of *Abies balsamea* (N.Y.)

Botryosphaeria dothidea (Moug.:Fr.) Ces. & De Not., on *Pinus strobus* (Ga.)

Botryosphaeria obtusa (Schw.) Shoemaker, on *Chamaecyparis thyoides* (N.J.), on *Juniperus virginiana* (Md., N.J., N.Y., Va.), on *Pinus strobus* (N.Y.)

Botryosphaeria querциum (Schw.) Sacc., on *Chamaecyparis thyoides* (N.J.), on *Juniperus virginiana* (N.Y.)

Botryosphaeria ribis Gross. & Duggar, on twigs of *Chamaecyparis thyoides* (Ga., S.C.), on *Juniperus virginiana* (Ala., N.J., Va.), on *Picea abies* (Ill.), on *Pinus strobus* (Ga.)

Capnodium pini Berk. & Curtis, black mildew on needles of *Pinus strobus* (widespread)

Coccodothis sphaeroidea (Cooke) Theiss. & Syd., on foliage of *Juniperus virginiana* (Ga., La., N.C., S.C.)

Cucurbitothis pithyophila (Schmidt & Kunze:Fr.) Petr., on *Pinus strobus* (Mich., Wash.)

Delphinella balsameae (A.M. Waterman) E. Mueller in E. Mueller & Arx, needle blight on *Abies balsamea* (New England states)

Delphinella peckii (Lindau) Barr, on cone scales of *Tsuga canadensis* (N.Y.)
Dimerium balsamicola (Peck) Shoemaker, on *Abies balsamea* (northeastern states), on *Picea* sp. (northeastern states)
Dothidea acerva Barr, on *Juniperus communis* (Mass., N.H.)
Glonium stellatum Muehlenberg, on *Tsuga canadensis* (N.C.)
Herpotrichia juniperi (Duby) Petr., brown felt blight, on *Juniperus communis* (western states), on *Picea abies* (Colorado, Oreg., Wyom.)
Hysterium macrosporum Gerard in Peck, on *Pinus* sp. (N.Y.)
Hysterographium flexuosum (Schw.:Fr.) Sacc., on *Pinus virginiana* (N.J.)
Kirschsteiniothelia thujina (Peck) Hawksworth, on wood of *Abies balsamea* (Maine)
Mycosphaerella dearnessii Barr, on *Pinus resinosa* (Wisc.), on *Pinus rigida* (La., N.C., Tenn.), on *Pinus strobus* (N.C.), on *Pinus sylvestris* (Iowa, Kans., Kentucky, Minn., Mo., Ohio, Wisc.), on *Pinus virginiana* (Ga., N.C.)
Mycosphaerella juniperina (Ellis) Tomilin, on foliage of *Juniperus communis* (Iowa), on *Juniperus virginiana* (Md., Okla.)
Mytilinidion decipiens (Karst.) Sacc., on bark of *Juniperus virginiana* (Kans., Miss., N.C., N.J.)
Mytilinidion mytilinellum (Fr.) Zogg, on *Pinus strobus* (Mich.)
Mytilinidion tortile (Schw.) Ellis & Everh., on *Juniperus virginiana* (Ga.)
Neopeckia coulteri (Peck) Sacc. in Peck, brown felt blight on *Pinus strobus* (Mont.)
Phaeocryptopus nudus (Peck) Petr., needle cast, black mildew on *Abies balsamea* (Maine, N.C., N.Y., Wisc.), on *Tsuga canadensis* (N.C., N.Y.)
Phaeocryptopus pinastri (Ellis & Sacc.) Petr., on *Pinus rigida* (Ga., N.J.)
Pododimeria gelatinosa Luttrell & Barr, on *Juniperus virginiana* (Va.)
Pododimeria juniperi (Batista) Luttrell & Barr, on *Juniperus virginiana* (Ga., N.J.)
Maurodothina fariae Pirozynski & Shoemaker, black mildew on living needles of *Abies balsamea* (N.Y.)
Rasutoria tsugae (Dearn.) Barr, on needles of *Tsuga canadensis* (Conn., N.H., Tenn., W.Va.)
Rebentischia massalongii (Mont.) Sacc., on limbs of *Abies balsamea* (Maine)
Scorias spongiosa (Schw.:Fr.) Fr., snow mold on *Pinus strobus* (Ind.)
Seynesiella exigua Barr, on dead leaves of *Juniperus communis* (Maine, N.H., Vt.)
Seynesiella juniperi (Desmaz.) G. Arnaud, on foliage of *Juniperus virginiana* (N.J.)
Strigopodia resiniae (Sacc. & Bres.) Hughes, on *Abies balsamea* (N.H.), on *Picea rubens* (Maine)

PATELLARIALES

Holmiella sabina (De Not) Petrini, Samuels, & E. Mueller, on wood of *Juniperus communis* (Mont.), on *Juniperus virginiana* (Kan., N.Y.)
Rhizodiscina lignyota (Fr.:Fr.) Hafellner, on *Juniperus virginiana* (Ga.)
Murangium sequoiae (Plowr. ex Phill.) Seaver, on bark of *Juniperus virginiana* (S.C.)

UREDINALES

Chrysomyxa arctostaphyli Dietel, on *Picea abies* (Mont., Wash.), on *Picea glauca* (Wash., Wyom.)
Chrysomyxa empetri J. Schroet. ex Cummins, on *Picea rubens* (Maine)
Chrysomyxa ledi de Bary, on *Picea glauca* (S.D.), on *Picea mariana* (widespread), on *Picea rubens* (Maine)
Chrysomyxa ledi de Bary var. *cassandrae* (Peck & Clinton) Savile, on *Picea glauca* (Minn., Wisc.), on *Picea mariana* (widespread), on *Picea rubens* (Mich., N.Y.)
Chrysomyxa ledicola Lagerh., on *Picea glauca* (Ark., Minn.), on *Picea mariana* (widespread), on *Picea rubens* (N.H., N.Y.)
Chrysomyxa pirolata Wint. in Rabenb., on *Picea glauca* (Ark., Maine, Mich.), on *Picea mariana* (Ark., Mass., N.H., Pa.), on *Picea rubens* (Maine, N.Y., Pa., Vt.)
Chrysomyxa roanensis (Arth.) Arth., on *Picea rubens* (Tenn.)
Chrysomyxa weiri H. Jacks., on *Picea glauca* (S.D.), on *Picea rubens* (Tenn.)
Coleosporium asterum (Dietel) Syd. & P. Syd., on *Pinus banksiana* (widespread), on *Pinus resinosa* (northeastern states, Ill., Minn.), on *Pinus rigida* (eastern states, Maryland, Mass., N.C., Ohio, Pa.), on *Pinus sylvestris* (N.J.), on *Pinus virginiana* (Ga., Pa., Tenn., Va.)
Coleosporium delicatulum Arth., on *Pinus resinosa* (widespread), on *Pinus rigida* (widespread)
Coleosporium helianthi (Schw.) Arth., on *Pinus rigida* (N.C.), on *Pinus virginiana* (eastern states, southeastern states, N.C., Ohio, S.C.)
Coleosporium inconspicuum Arth., on *Pinus virginiana* (southeastern states, N.C., Ohio, Tenn.)

Coleosporium ipomoeae (Schw.) Burrill, on *Pinus rigida* (eastern states, Ala.)
Coleosporium laciniariae Arth., on *Pinus rigida* (eastern states)
Coleosporium pinicola Arth., on *Pinus rigida* (Mass.), on *Pinus virginiana* (widespread)
Coleosporium tussilaginis (Pers.) Lev. in C. d'Orb., on *Pinus resinosa* (Mich., N.H., N.Y.), on *Pinus rigida* (eastern states, Ohio), on *Pinus sylvestris* (N.Y., Wisc.)
Coleosporium vernoniae Berk. & Curtis in Berk., on *Pinus rigida* (widespread), on *Pinus sylvestris* (Ohio)
Cronartium coleosporioides Arth., on *Pinus banksiana* (Mich.), on *Pinus sylvestris* (S.D.)
Cronartium comandrae Peck, on *Pinus resinosa* (Conn.), on *Pinus rigida* (Conn., N.J.), on *Pinus sylvestris* (eastern states)
Cronartium comptoniae Arth., on *Pinus banksiana* (northeastern states, Minn., Wisc.), on *Pinus resinosa* (northeastern states, Minn.), on *Pinus rigida* (northeastern states), on *Pinus sylvestris* (northeastern states, central states, Wisc.), on *Pinus virginiana* (Md., N.C., N.J., Pa.)
Cronartium quercuum (Berk.) Miyabe ex Shirai, on *Pinus banksiana* (Conn., Mich., Minn., Wisc.), on *Pinus resinosa* (Minn., N.J.), on *Pinus rigida* (northeastern states, Kentucky, Tenn.), on *Pinus sylvestris* (Mich., N.C.), on *Pinus virginiana* (widespread)
Cronartium quercuum (Berk.) Miyabe ex Shirai f. sp. *banksianae* Burdsall & G. Snow, on *Pinus banksiana* (Minn., Wisc.)
Cronartium quercuum (Berk.) Miyabe ex Shirai f. sp. *virginianae* Burdsall & G. Snow, on *Pinus virginiana* (Va.)
Cronartium ribicola J.C. Fisch., on *Pinus resinosa* (Minn.), on *Pinus strobus* (eastern states, Great Lake states, N.C., Tenn., Va., Wash.)
Endocronartium harknessii (J.P. Moore) Hiratsuka, on *Pinus banksiana* (Idaho, Mich., Minn.), on *Pinus sylvestris* (widespread)
Gymnosporangium asiaticum Miyabe ex G. Yamada, on *Juniperus virginiana* (Wisc.)
Gymnosporangium bermudianum Earle in Seym. & Earle, on *Juniperus virginiana* (Ala., Fla., La., Miss.)
Gymnosporangium clavariiforme (Wulfen in Jacq.:Pers.) DC., on *Juniperus communis* (western states)
Gymnosporangium clavipes (Cooke & Peck) Cooke & Peck in Peck, on *Juniperus communis* (widespread)
Gymnosporangium cornutum Arth. ex F. Kern, on *Juniperus communis* (western states, Maine, Mich.)
Gymnosporangium davisii F. Kern, on *Juniperus communis* (Maine, Wisc.), on *Juniperus virginiana* (Fla.)
Gymnosporangium effusum F. Kern, on *Juniperus virginiana* (Md., N.J., N.Y., S.C., Va.)
Gymnosporangium exiguum F. Kern, on *Juniperus virginiana* (Texas)
Gymnosporangium exterum Arth. & Kern in Arth., on *Juniperus virginiana* (Ky., Va.)
Gymnosporangium floriforme Thaxt. in F. Kern, on *Juniperus virginiana* (southeastern states, Okla., Texas)
Gymnosporangium globosum (Farl.) Farl., on *Juniperus virginiana* (widespread)
Gymnosporangium juniperi-virginiae Schw., on *Juniperus horizontalis* (Ill.), on *Juniperus virginiana* (widespread)
Gymnosporangium nelsonii Arth., on *Juniperus virginiana* (N.Y.)
Gymnosporangium nidus-avis Thaxt., on *Juniperus virginiana* (Conn., Ga., Mass., Miss., N.C., Okla., S.D.)
Gymnosporangium trachysorum F. Kern ex Arth., on *Juniperus virginiana* (La., Miss., S.C.)
Melampsora abieti-capraeарum Tub., on *Abies balsamea* (widespread)
Melampsora abietis-canadensis C.A. Ludw. ex Arth., on *Tsuga canadensis* (northeastern states, northcentral states, N.C., Va., Wisc.)
Melampsora farlowii (Arth.) J.J. Davis, on *Tsuga canadensis* (eastern states, N.C., Va., Wisc.)
Melampsora medusae Thuem., on *Larix laricina* (widespread)
Melampsora paradoxa Dietel & Holw. in Dietel, on *Larix laricina* (widespread)
Melampsorella caryophyllacearum J. Schroet., on *Abies balsamea* (widespread), on *Picea abies* (Idaho, Mont., Wash., Wyom.), on *Picea glauca* (widespread), on *Picea rubens* (Maine, N.Y.)
Melampsoridium betulinum Kleb., on *Larix laricina* (Conn., Wisc.)
Milesina fructuosa (Faull) Hiratsuka, on *Abies balsamea* (Maine, N.H., N.Y.)
Milesina marginalis (Faull & Watson) Faull & Watson ex Hiratsuka, on *Abies balsamea* (Mass., N.H., N.Y.)
Milesina pycnograndis (Arth.) Hiratsuka, on *Abies balsamea* (Maine, N.H., N.Y.)
Peridermium cerebrum Peck, on *Pinus rigida* (N.Y.)
Peridermium coloradense (Dietel) Arth. & F. Kern, on *Picea glauca* (Ark.)
Peridermium comptoniae Orton & J.F. Adams, on *Pinus sylvestris* (Conn.)
Peridermium harknessii J.P. Moore, on *Pinus sylvestris* (S.D.)
Peridermium stalactiforme Arth. & F. Kern, on *Pinus banksiana* (Minn.)
Pucciniastrum arcticum Tranzschel, on *Picea glauca* (widespread)
Pucciniastrum epilobii G. Otth, on *Abies balsamea* (Mich., N.Y., Vt., Wisc.)
Pucciniastrum goeppertianum (Kuehn) Kleb., on *Abies balsamea* (Maine, Pa., Wisc.)
Pucciniastrum hydrangeae (Magnus) Arth., on *Tsuga canadensis* (Ind., Md., N.C., Pa., Tenn., Va., W.Va.)

Pucciniastrum pustulatum Dietel in Engl. & Prantl, on *Abies balsamea* (Mich., Minn., N.Y., Wisc.)

Pucciniastrum vaccinii (G. Wint.) Jorst., on *Tsuga canadensis* (eastern states, Ga., Ind., Wisc.)

Uredinopsis americana P. Syd. & Syd., on *Abies balsamea* (widespread)

Uredinopsis osmundae Magnus, on *Abies balsamea* (widespread)

Uredinopsis phegopteris Arth., on *Abies balsamea* (Wisc.)

Uredinopsis struthiopteris Stoermer ex Dietel, on *Abies balsamea* (Mich.)

TULASNELLALES

Tulasnella fuscoviolacea Bres., on bark of *Abies balsamea* (N.H.), on *Picea rubens* (N.H.), on *Picea* sp. (N.Y.)

Oliveonia subviolacea (Peck) Larsen, on bark of *Pinus strobus* (Mass.), of *Tsuga canadensis* (N.C., N.Y.)

Uthatobasidium fusicolor (J. Schroet.) Donk, on *Pinus rigida* (Pa.)

TREMELLALES

Exidiopsis calcea (Pers.) K. Wells, on *Juniperus virginiana* (Fla.), on *Picea glauca* (Ark.), on *Picea mariana* (Minn.), on *Pinus rigida* (N.H.), on *Tsuga canadensis* (N.Y.)

Exidiopsis podlachica (Bres.) Ervin, on fallen logs of *Pinus strobus* (Mass.)

Heterochaete shearrii (Burt) Burt, on dead limbs of *Juniperus virginiana* (La.)

Protodontia piceicola (Bourd.) G.W. Martin, on *Tsuga canadensis* (Wisc.)

Pseudohydnum gelatinosum (Scop.:Fr.) Karst., on *Tsuga canadensis* (N.C.)

Sebacina epigaea (Berk. & Broome) Bourd. & Galzin, on wood of *Juniperus virginiana* (Ga., La.)

Sebacina incrassans (Pers.:Fr.) Tul., at base of living trees of *Juniperus virginiana* (Fla.)

AURICULARIALES

Auricularia auricula (L.:Fr.) Underw., on *Abies balsamea* (Minn.), on *Picea glauca* (Minn.), on *Picea rubens* (Conn., Maine, N.H., N.Y.)

Platygloea acanthophysa Burdsall, on wood of *Tsuga canadensis* (Wisc.)

Platygloea unispora Olive, on limbs of *Chamaecyparis thyoides* (Ga.)

DACRYMYCETALES

Arrhytidia involuta (Schw.) Coker, on *Pinus rigida* (N.Y.), on *Tsuga canadensis* (W.Va.)

Calocera cornea (Batsch:Fr.) Fr., on *Juniperus virginiana* (Ind.), on *Tsuga canadensis* (Mass.)

Cerinomyces pallidus G.W. Martin, on *Tsuga canadensis* (Wisc.)

Dacrymyces minor Peck, on wood of *Pinus strobus* (N.Y.)

Dacrymyces minutus (Olive) McNabb, on wood of *Tsuga canadensis* (N.C.)

Dacrymyces tortus (Wild.:Fr.) Fr., on *Picea glauca* (N.Y.)

Dacryopinax spathularia (Schw.:Fr.) G.W. Martin, on wood of *Tsuga canadensis* (N.Y.)

APHYLLOPHORALES

Acanthophysium fennicum (Laurila) Parmasto, on limbs and twigs of *Picea rubens* (N.H., N.Y., Vt.)

Acanthophysium lividocaeeruleum (Karst.) Boudin, on *Picea glauca* (Ark.)

Acanthophysium weiri (Burt) Parmasto, on bark of *Larix laricina* (Mich.)

Albatrellus caeruleoporus (Peck) Pouzar, in *Tsuga canadensis* duff**

Albatrellus confluens (Alb. & Schw.:Fr.) Kotl. & Pouzar, on ground in *Tsuga canadensis* stand **

Aleurobotrys botryosus (Burt) Boidin et al., on bark of *Juniperus virginiana* (La.)

Aleurocystidiellum subcruentatum (Berk. & Curtis) Lemke, on limbs and trunks of *Picea rubens* (N.H., N.Y.)

Aleurodiscus abietis H. Jacks. & Lemke in Lemke, on living and dead limbs of *Abies balsamea* (N.Y., Vt.)

Aleurodiscus amorphus (Pers.:Fr.) Schroet. in Cohn, on weak, injured or recently dead trees of *Abies balsamea* (Conn., Maine, Mich., Minn., N.H., N.Y., Vt.), on *Larix laricina* (Minn.), on *Picea mariana* (N.Y.), on *Pinus strobus* (widespread), on *Tsuga canadensis* (northeastern states)

Aleurodiscus farlowii Burt, on *Tsuga canadensis* (northeastern states)

Aleurodiscus penicillatus Burt, on *Picea rubens* (N.H.), on *Tsuga canadensis* (Vt.)
Aleurodiscus piceinus Lyon & Lemke in Lemke, on dead stems and twigs of *Picea rubens* (N.H., Vt.)
Amphinema byssoides (Pers.:Fr.) Eriksson, on *Picea glauca* (Ark.), on *Pinus sylvestris* (Ohio), on *Tsuga canadensis* (N.Y.)
Amylocorticium canadense (Burt) Eriksson & Weresub in Weresub, on *Tsuga canadensis* (N.Y.)
Amylocorticium subincarnatum (Peck) Pouzar, on *Picea glauca* (Minn.)
Amylocystis lapponica (Romell) Sing., comb. inval., on *Picea glauca* (N.H.), on *Picea rubens* (N.H.)
Amylostereum chailletii (Pers.:Fr.) Boidin, on *Abies balsamea* (N.H., N.Y.), on *Chamaecyparis thyoides* (N.J.), on *Juniperus virginiana* (Conn., N.Y.), on *Picea glauca* (Ark.), on *Picea rubens* (N.Y.), on *Pinus sylvestris* (Conn.), on *Tsuga canadensis* (N.Y., Vt.)
Antrodia albida (Fr.:Fr.) Donk, on *Juniperus virginiana* (Mo., Pa., Va.), on *Picea glauca* (Ark.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Tsuga canadensis* (N.Y.)
Antrodia albobrunnea (Romell) Ryv., on *Picea glauca* (Ark.)
Antrodia heteromorpha (Fr.:Fr.) Donk, on *Abies balsamea* (New England states), on *Juniperus virginiana* (N.C.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Tsuga canadensis* (Maine, N.Y., Va.)
Antrodia juniperina (Murr.) Niemela & Ryv., on *Juniperus virginiana* (Fla.)
Antrodia odora (Peck in Sacc.) Gilb. & Ryv., on *Picea glauca* (Ark.)
Antrodia radiculosa (Peck) Gilb. & Ryv., on *Picea abies* **, on *Tsuga canadensis* (N.Y.)
Antrodia serialis (Fr.:Fr.) Donk, on *Abies balsamea* **, on *Picea glauca* (Ark.), on *Picea mariana* (Minn.), on *Picea rubens* (New England, Pa.), on *Pinus resinosa* (Minn.), on *Pinus rigida* **, on *Pinus virginiana* (widespread), on *Tsuga canadensis* (Maine, N.Y., Pa.)
Antrodia sinuosa (Fr.:Fr.) Karst., on *Abies balsamea* (New England states), on *Picea glauca* (Ark.), on *Picea mariana* (Great Lake states), on *Picea rubens* (New England states, **), on *Tsuga canadensis* (N.Y.)
Antrodia sordida Ryv. & Gilb., on *Picea mariana* (Minn.), on *Picea rubens* (N.H.), on *Pinus* sp. **
Antrodia vaillantii (Fr.) Ryv., on spruce boards **, on *Pinus* sp. **, on *Tsuga canadensis* (widespread)
Antrodia variiformis (Peck) Donk, on *Picea rubens* (New England states, N.Y.)
Antrodia xantha (Fr.:Fr.) Ryv., on *Abies balsamea* (Minn.), on *Picea glauca* (Ark.), on *Picea rubens* (Maine), on charred log of *Pinus* sp. **
Antrodiella overholtsii Ryv. & Gilb., on *Picea glauca* (Minn.), on conifer **
Asterodon ferruginosum Pat., on *Picea glauca* (Ark.), on *Picea rubens* (Conn., Maine, N.H., N.Y.)
Athelia laxa (Burt) Juelich, on *Tsuga canadensis* (Conn., Pa., Va.)
Athelia newhoffii (Bres.) Donk, on *Picea glauca* (Ark.)
Auriporia aurea (Peck) Ryv., on *Tsuga canadensis* (N.Y.)
Auriscalpium vulgare S.F. Gray, on cones of *Pinus rigida* (Mass.), on *Pinus sylvestris* (Kans.)
Basidioradulum radula (Fr.:Fr.) Nobles, on *Picea* sp. (N.Y.), on *Tsuga canadensis* (N.Y.)
Bjerkandera adusta (Willd.:Fr.) Karst., on *Juniperus virginiana* (widespread), on *Picea glauca* (Minn.), on *Tsuga canadensis* (S.C.)
Bondarzewia berkeleyi (Fr.) Bondartsev & Singer, on *Juniperus virginiana* (N.C.), on *Pinus strobus* (Minn.), on *Tsuga canadensis* **
Boreostereum radiatum (Peck) Parmasto, on *Picea glauca* (Ariz., Minn.), on *Picea mariana* (Minn., N.Y.), on *Picea rubens* (Maine), on *Tsuga canadensis* (N.H., N.Y., Pa., Va.)
Botryobasidium laeve (Eriksson) Parmasto, on *Pinus resinosa* (Mass.)
Botryobasidium pruinatum (Bres.) Eriksson, on *Picea glauca* (Minn.)
Botryobasidium subcoronatum (Hoehn. & Litsch.) Donk, on *Picea rubens* (N.Y.), on *Pinus strobus* (Mass.), on *Tsuga canadensis* (Wisc.)
Botryobasidium vagum (Berk. & Curtis) D.P. Rogers, on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (N.Y.)
Byssocorticium atrovirens (Fr.:Fr.) Bondartsev & Singer ex Singer, on *Pinus rigida* (N.Y.)
Ceraceomyces tessulatus (Cooke) Juelich, on wood of *Picea* sp. (Maine)
Ceriporia purpurea (Fr.:Fr.) Donk, on wood of *Juniperus virginiana* (Iowa), of *Picea glauca* (Ark.)
Ceriporia spissa (Schw.:Fr.) Rajch., on *Pinus* sp. **
Ceriporia viridens (Berk. & Br.) Donk, on *Picea* sp.
Ceriporia xylostromatoides (Berk.) Ryv. & Johansen, on bark of *Juniperus virginiana* (La.)
Cerocorticium sulfureo-isabellinum (Litsch.) Juelich & Stalpers, on *Abies balsamea* (Ariz., Minn., N.H.)
Cerrena unicolor (Bull.:Fr.) Murr., on *Pinus virginiana* (Va.)
Chaetoderma luna (Romell ex D.P. Rogers & Jacks.) Parmasto, on *Picea glauca* (Ark.)
Clavicorona pyxidata (Pers.:Fr.) Doty, on *Tsuga canadensis* (N.C., Va.)

Climacocystis borealis (Fr.:Fr.) Kotlaba & Pouzar, on *Abies balsamea* **, on *Picea mariana* (Minn., N.Y., Tenn.), on *Picea rubens* (N.Y., Tenn., Vt.), on *Tsuga canadensis* (Mass., N.C., N.Y., Tenn., Va.)

Coltricia focicola (Berk. & Curtis) Murr., on burnt soil under *Pinus rigida* **

Coltriciella dependens (Berk. & Curtis) Murr., on *Pinus rigida* (N.J., **)

Columnnocyttis abietina (Pers.:Fr.) Pouzar, on *Picea glauca* (Ark.), on *Picea mariana* (Ark., N.Y.), on *Picea rubens* (N.Y.), on *Pinus* sp. (widespread), on fallen logs of *Tsuga canadensis* (Mich.)

Columnnocyttis ambigua (Peck) Pouzar, on *Picea rubens* (Maine, N.C., N.H., Tenn.), on *Pinus* sp. (northeastern states), on *Tsuga canadensis* (Tenn.)

Confertobasidium olivaceo-album (Bourd. & Galzin) Juelich, on *Pinus resinosa* (Mass.), on *Pinus strobus* (Mass.)

Coniophora arida (Fr.:Fr.) Karst., on *Chamaecyparis thyoides* (N.J.), on *Pinus virginiana* (Md.), on *Pinus* sp. (widespread)

Coniophora arida (Fr.:Fr.) Karst. var *suffocata* (Peck) Ginns, on *Pinus rigida* (Pa.), on *Pinus strobus* (Mass.), on *Tsuga canadensis* (Pa.)

Coniophora fusispora (Cooke & Ellis) Sacc., on *Juniperus virginiana* (Ala., Fla.), on *Pinus rigida* (Mass.)

Coniophora olivacea (Pers.:Fr.) Karst., on *Chamaecyparis thyoides* (N.J.), on *Pinus* sp. (N.J., N.Y.)

Coniophora puteana (Schumach.:Fr.) Karst., on *Abies balsamea* (New England states), on *Picea rubens* (Ark.), on *Tsuga canadensis* (widespread)

Corticium minnsiae (Jacks.) Boidin & Lanquetin, on wood of *Tsuga canadensis* (Maine, N.C., N.Y., Vt.)

Corticium pini (H. Jacks.) Boid. & Lang., on *Pinus strobus* (N.Y.)

Crustoderma dryinum (Berk. & Curtis) Parmasto, on *Picea glauca* (Ark.)

Cryptoporus volvatus (Peck) Shear, on *Picea rubens* **, on *Pinus resinosa* (Mich., Minn., **), on *Pinus rigida* (Mass., N.Y., Vt.), on *Pinus virginiana* (D.C., Md., Va.)

Cystostereum murrayi (Berk. & Curtis) Pouzar, on *Picea rubens* (N.H.)

Cystostereum pini-canadense (Schw.) Parmasto, on *Abies balsamea* (Minn.), on *Picea abies* (N.Y.), on *Picea rubens* (N.H.), on *Tsuga canadensis* (Mich.)

Dacryobolus karstenii (Bres.) Oberwinkler ex Parmasto, on *Picea glauca* (Ark.)

Dacryobolus sudans (Albertini & Schw.:Fr.) Fr., on *Juniperus virginiana* (Fla.)

Dendrophora albobadia (Schw.:Fr.) Chamuris, on dead limbs of *Juniperus virginiana* (La.)

Dendrothele griseo-cana (Bres.) Bourd. & Galzin, on bark of *Juniperus virginiana* (La.)

Dendrothele incrustans (Lemke) Lemke, on wood of *Juniperus virginiana* (La.)

Dendrothele itilummensis Gilb. & Blackwell, on limbs of *Juniperus virginiana* (La., Miss.)

Dendrothele nivosa (Berk. & Curtis ex Hoehn. & Litsch.) Lemke, on bark of *Juniperus virginiana* (Ark., Conn., Fla., Ga., Ind., Kan., La., Mass., Miss., Mo., N.C., N.J., N.Y., Okla., Pa., S.C., Tenn., Texas)

Dendrothele pachysterigmata (Jacks. & Lemke) Lemke, on dead limbs of *Juniperus virginiana* (La.)

Dichomitus squalens (Karst.) D. Reid, on *Picea glauca* (Ark., Minn.), on *Picea mariana* (Minn., N.Y.), on *Picea rubens* (Conn., Maine, N.H., N.Y., Vt.), on *Pinus banksiana* (Mich.), on *Pinus resinosa* (Minn., N.H.), on *Pinus strobus* (Mich., Vt.), on *Tsuga canadensis* (Mass.)

Dichostereum effucatum (Cooke & Ellis) Boidin & Lanquetin, on *Tsuga canadensis* (Conn.)

Diplomitoporus crustulinus (Bres.) Domanski, on *Picea glauca* (Ark.), on *Picea glauca* (Ark.), on *Picea* sp. **

Diplomitoporus litobladii (Berk.) Gilb. & Ryv., on *Picea glauca* (Ark.), on *Pinus rigida* **, on *Tsuga canadensis* **

Diplomitoporus rimosus (Murr.) Gilb. & Ryv., on *Juniperus virginiana* (Okla.)

Echinodontium ballouii (Banker) H. Gross, on wood of *Chamaecyparis thyoides* (N.J.)

Fibulomyces septentrionalis (Eriksson) Juelich, on *Picea glauca* (Ark.)

Fomitopsis cajanderi (Karst.) Kotlaba & Pouzar, on *Chamaecyparis thyoides* (N.C., N.J.), on *Juniperus virginiana* (Ind., S.C., Tenn.), on *Larix laricina* (widespread), on *Picea abies* (N.C.), on *Picea glauca* (widespread), on *Picea rubens* (New England states, N.Y.), on *Pinus virginiana* (Md., Va.), on *Tsuga canadensis* (N.C., N.Y., Pa., Va.)

Fomitopsis feei (Fr.) Kreisel, on wood of *Juniperus virginiana* (Fla., La.)

Fomitopsis officinalis (Villars:Fr.) Bondartsev & Singer, on *Abies balsamea* (Minn.), on *Larix laricina* (Wisc.), on *Picea glauca* (Minn., S.D.), on *Picea mariana* (Minn.), on *Pinus strobus* (Mich.), on *Tsuga canadensis* (Mich.)

Fomitopsis pinicola (Sw.:Fr.) Karst., on *Abies balsamea* (Minn.), on *Larix laricina* (N.Y., Wisc.), on *Picea glauca* (Ark.), on *Picea mariana* (Minn.), on *Picea rubens* (Conn., Maine, N.H., N.Y., Tenn.), on *Pinus banksiana* (widespread), on *Pinus resinosa* (widespread), on *Pinus rigida* (widespread), on *Pinus strobus* (widespread), on *Pinus virginiana* (eastern states, Tenn.), on *Tsuga canadensis* (widespread, **)

Fomitopsis rosea (Albertini & Schw.:Fr.) Karst., on *Abies balsamea* **, on *Juniperus virginiana* (Ala., Fla., Md., Pa., Va.), on *Picea glauca* (Ark.), on *Picea mariana* (Minn.), on *Picea mariana* (Conn., Maine, N.H., N.Y.), on *Pinus banksiana* (widespread), on *Pinus strobus* (widespread), on *Pinus virginiana* (Md., Va.), on *Tsuga canadensis* (eastern states)

Fomitopsis spraguei (Berk. & Curtis) Gilb. & Ryv., on *Tsuga canadensis* (N.C., N.Y.)
Galzinia cymosa D.P. Rogers, on *Pinus resinosa* (Mass.), on *Pinus rigida* (Mass.)
Ganoderma appланatum (Pers.) Pat., on *Abies balsamea* (N.Y.), on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (Mich., N.Y., Pa.)
Ganoderma lucidum (Curtis:Fr.) Karst., on *Picea abies* (Pa.), on *Picea* sp. **, on *Tsuga canadensis* (widespread)
Ganoderma tsugae Murr., on *Picea abies* (Pa.), on *Pinus rigida* (Pa.), on *Tsuga canadensis* (widespread, **)
Gloeocystidiellum ochraceum (Fr.:Fr.) Donk, on *Pinus resinosa* (Mass.)
Gloeocystidiellum porosum (Berk. & Curtis) Donk, on *Picea mariana* (N.Y.), on *Pinus resinosa* (Wisc.)
Gloeophyllum carbonarium (Berk. & Curtis) Ryv., on *Tsuga canadensis* (N.Y., Pa.)
Gloeophyllum odoratum (Fr.) Imaz., on *Juniperus virginiana* (N.Y.), on *Picea glauca* (Ark.), on *Pinus virginiana* (Md., Pa., Va.), on *Tsuga canadensis* (Maine, Wisc.)
Gloeophyllum sepiarium (Fr.) Karst., on *Abies balsamea* (New England states, Minn.), on *Chamaecyparis thyoides* (Va.), on *Larix laricina* (Ark.), on *Picea glauca* (Ark., Maine, Mont., N.M., N.Y., S.D., Vt., Wash., Wyom.), on *Picea mariana* (Minn., N.Y.), on *Picea rubens* (N.C.), on *Pinus strobus* (widespread), on *Tsuga canadensis* (widespread, **)
Glociphilum trabeum (Pers.:Fr.) Murr., on *Juniperus virginiana* (Pa.), on *Picea mariana* (N.Y.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Pinus rigida* **, on *Tsuga canadensis* (widespread)
Gloeoporus dichrous (Fr.:Fr.) Bres., on *Juniperus virginiana* (widespread), on *Picea mariana* (N.Y.), on *Pinus resinosa* (Minn.), on *Tsuga canadensis* (N.Y.)
Gloeoporus taxicola (Pers.:Fr.) Gilb. & Ryv., on *Picea* sp. **
Grandinia ahutaria (Burt) Juelich, on *Picea glauca* (Minn.)
Grandinia arguta (Fr.:Fr.) Juelich, on *Pinus* sp. (N.Y.)
Grandinia breviseta (Karst) Juelich, on *Abies balsamea* (Minn.), on *Picea mariana* (Minn.)
Grandinia crustosa (Pers.:Fr.) Fr., on *Juniperus virginiana* (Fla.)
Grandinia floccosa (Bourd. & Galzin) Juelich, on *Pinus resinosa* (N.Y.)
Grandinia granulosa (Pers.:Fr.) Fr., on *Picea glauca* (Minn.)
Grandinia nespori (Bres.) Cejp, on dead limbs of *Juniperus virginiana* (Fla.)
Grandinia pallidula (Bres.) Juelich, on *Pinus resinosa* (Minn.), on *Tsuga canadensis* (Wisc.)
Grandinia spathulata (Schrad.:Fr.) Juelich, on *Juniperus virginiana* (Fla.), on *Pinus resinosa* (Minn., N.Y.), on *Tsuga canadensis* (N.Y.)
Grandinia stenospora (Karst.) Juelich, on *Picea glauca* (Ark., Minn.), on *Pinus resinosa* (Minn., N.Y.), on *Pinus strobus* (Mass.)
Grandinia subalutacea (Karst.) Juelich, on *Pinus resinosa* (Minn.), on *Pinus strobus* (N.Y.)
Hapalopilus salmonicolor (Berk. & Curtis) Pouzar, on *Picea* sp. **, on *Pinus strobus* **
Henningsomyces candidus (Pers.:Fr.) Kuntze, on *Juniperus virginiana* (La.), on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (Tenn.)
Hericium americanum Ginns, on wood of *Tsuga canadensis* (N.Y.)
Heterobasidion annosum (Fr.:Fr.) Bref., on *Chamaecyparis thyoides* (Mich., N.Y.), on *Juniperus virginiana* (Del., Ga., Maryland, Mass., N.C., N.Y., S.C., Tenn., Va.), on *Picea glauca* (Minn.), on *Picea rubens* (Maine, Vt.), on *Pinus banksiana* (widespread), on *Pinus resinosa* (northeastern states, Maine, Calif., Mich., Minn., N.H., N.Y., Vt.), on *Pinus rigida* (northeastern states, Mass., N.C.), on *Pinus strobus* (northern states, north central states, Iowa, N.C.), on *Pinus sylvestris* (Conn., Mich.), on *Pinus virginiana* (Md., N.C., Ohio, Va.), on *Tsuga canadensis* (Conn., **)
Hexagonia papyracea Berk., on *Thuja occidentalis* **
Hymenochaete agglutinans Ellis, on *Pinus strobus* (Pa.), on *Tsuga canadensis* (Pa.)
Hymenochaete tabacina (Sowerby:Fr.) Lev., on wood of *Abies balsamea* (New England states, N.Y.), on *Picea rubens* (Conn., Mainc, N.H., N.Y.)
Hymenochaete tenuis Peck, on *Picea glauca* (Ark.)
Hyphoderma argillaceum (Bres.) Donk, on *Tsuga canadensis* (Wisc.)
Hyphoderma baculorubrense Gilb. & Blackwell, on *Juniperus virginiana* (Fla.)
Hyphoderma obtusiforme Eriksson & Strid in Eriksson & Ryv., on wood of *Juniperus virginiana* (Fla.)
Hyphoderma pilosum (Burt) Gilb. & Budington, on *Abies balsamea* (Minn.)
Hyphoderma praetermissum (Karst.) Eriksson, on *Juniperus virginiana* (La.), on *Pinus resinosa* (Mass.)
Hyphoderma setigerum (Fr.:Fr.) Donk, on *Abies balsamea* (Minn.)
Hyphoderma tsugae (Burt) Eriksson & Strid in Eriksson et al., on *Tsuga canadensis* (N.H.)
Hyphodermopsis polonensis (Bres.) Juelich, on *Abies balsamea* (Minn.)
Hyphodontia stipata (Fr.:Fr.) Gilb., on *Abies balsamea* (Minn.)

Hypochnicium bombycinum (Sommerf.Fr.) Eriksson, on dead limbs of *Juniperus virginiana* (Fla.)
Hypochnicium eichleri (Bres.) Eriksson & Ryv., on dead limbs of *Juniperus virginiana* (La.)
Hypochnicium lundellii (Bourd.) Eriksson, on dead limbs of *Juniperus virginiana* (La.)
Hypochnicium punctulatum (Cooke) Eriksson, on wood of *Juniperus virginiana* (Fla.)
Inonotus circinatus (Fr.) Gilb., on *Abies balsamea* (New England states, Minn.), on *Picea glauca* (Minn.), on *Picea mariana* (Minn.), on *Pinus banksiana* (widespread), on *Pinus resinosa* (Minn.), on *Pinus rigida* (Pa.), on *Pinus strobus* (Minn., N.C., N.Y.), on *Tsuga canadensis* (N.Y., Wise.)
Inonotus tomentosus (Fr.:Fr.) S. Teng, on *Picea abies* (W.Va.), on *Picea glauca* (Ark.), on *Pinus strobus* (N.C.)
Irpea lacteus (Fr.:Fr.) Fr., on *Tsuga canadensis* (Vt.)
Ischnoderra resinosum (Sehrad.:Fr.) Karst., on *Juniperus virginiana* (N.C.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (Maine, N.C., **, Tenn., Vt.)
Jahnoporus hirtus (Quel. ex Cooke) Donk, on roots of *Abies balsamea* (Mich.)
Jungludnia collabens (Fr.) Ryv., on *Picea glauca* (S.D.), on *Picea mariana* (Minn.), on *Picea rubens* (N.H., N.Y.), on *Tsuga canadensis* (N.Y.)
Jungludnia luteoalba (Karst.) Ryv., on *Picea rubens* (N.H.), on *Pinus rigida* (Pa.), on *Pinus strobus* (Mass., N.Y.), on *Pinus sylvestris* (N.Y.)
Jungludnia nitida (Pers.:Fr.) Ryv., on *Picea rubens* (N.Y.), on *Tsuga canadensis* (Pa.)
Jungludnia subfimbriata (Romell) Ginns, on *Picea rubens* (Maine)
Laetiporus sulphureus (Bull.:Fr.) Murr., on *Picea glauca* (Maine), on *Picea rubens* (Maine), on *Pinus resinosa* (Minn.), on *Pinus strobus* (Wisc.), on *Tsuga canadensis* (N.C.)
Laurilia sulcata (Burt) Pouzar, on *Picea glauca* (Ark.), on *Tsuga canadensis* (N.H., N.Y., Pa., Vt., Wise.)
Lenzites betulinus (L.:Fr.) Fr., on *Tsuga canadensis* (N.Y.)
Leptoporus mollis (Pers.:Fr.) Pilat, on *Tsuga canadensis* **
Leptosporomyces galzinii (Bourd.) Juelich, on living limbs of *Juniperus communis* (Mass.)
Leucogyrophana mollusca (Fr.:Fr.) Pouzar, on wood of *Abies balsamea* (Maine)
Lindneria leucobryophila (Henn.) Juelich, on *Pinus resinosa* (Minn.)
Meruliodopsis albostramineus (Torrend) Juelich & Stalpers, on wood of *Tsuga canadensis* (N.C.)
Meruliodopsis corium (Fr.:Fr.) Ginns, on *Picea mariana* (Minn.)
Meruliodopsis taxicola (Pers.) Bondartsev in Parmasto, on *Chamaecyparis thyoides* (N.J.), on *Picea rubens* (N.H.)
Meruliporia incrassata (Berk. & Curtis) Murr., on *Tsuga canadensis* (widespread)
Oligoporus balsameus (Peek) Gilb. & Ryv., on *Picea* sp. **
Oligoporus floriformis (Quel.) Gilb. & Ryv., on *Thuja occidentalis* **, on *Pinus strobus* **
Oligoporus leucomallellus (Murr.) Gilb. & Ryv., on *Picea* sp. **, on *Pinus strobus* **
Oligoporus fragilis (Fr.) Gilb. & Ryv., on *Pinus sylvestris*?
Oligoporus guttulatus (Peek) Gilb. & Ryv., on conifer **
Oligoporus mappus (Overh. & Lowe) Gilb. & Ryv., on conifer bridge rail **
Oligoporus minusculoides (Pilat) Gilb. & Ryv., on *Tsuga canadensis* **
Oligoporus sericeomollis (Rom.) Pouzar, on *Pinus rigida* **, on *Pinus strobus* **
Oligoporus stipticus (Pers.:Fr.) Gilb. & Ryv., on *Tsuga canadensis* **
Oligoporus subpendulus (Atk.) Gilb. & Ryv., on *Tsuga canadensis* (N.Y.)
Pachykytospora papyracea (Schw.) Ryv., on dead wood of *Chamaecyparis thyoides* (N.J., N.Y., Pa.)
Parmastomyces transmutans (Overh.) Ryv. & Gilb., on *Pinus strobus* **
Paullicorticium pearsonii (Bourd.) Eriksson, on *Tsuga canadensis* (Wise.)
Peniophora junipericola Eriksson, on dead limbs of *Juniperus virginiana* (La., Miss.)
Peniophora piceae (Pers.) Eriksson, on *Abies balsamea* (Minn.)
Peniophora pini (Schlecht.:Fr.) Boidin subsp. *duplicata* (Burt) Weresub & Gibson, on *Pinus rigida* (Conn., Mass., N.Y., Pa.), on *Pinus strobus* (Mass., Pa.), on *Pinus sylvestris* (Mass., Pa.), on *Pinus virginiana* (Md., Pa.)
Peniophora pseudopini Weresub & Gibson, on *Pinus resinosa* (N.Y.), on *Pinus strobus* (Mass., Pa.)
Peniophora pusilla H. Jacks., on bark of *Tsuga canadensis* (N.H.)
Perenniporia medulla-panis (Jacq.:Fr.) Donk, on *Picea* sp. **
Perenniporia subacida (Peek) Donk, on *Abies balsamea* (widespread), on *Juniperus virginiana* (Idaho, N.Y.), on *Picea glauca* (Maine), on *Picea rubens* (Conn., Maine, N.H., N.Y., Vt.), on *Pinus resinosa* (Great Lake states), on *Pinus strobus* (north-eastern states), on *Pinus virginiana* (Md., Va.), on *Tsuga canadensis* (eastern states, **)
Perenniporia tenuis (Schw.) Ryv., on wood of *Picea* sp. (N.Y., Pa.), on *Tsuga canadensis* (N.C.)
Phaeolus schweinitzii (Fr.:Fr.) Pat., on *Abies balsamea* (New England states, N.Y.), on *Larix laricina* (widespread, **), on

Picea abies **, on *Picea glauca* (widespread), on *Picea mariana* (New England states, Minn.), on *Picea rubens* (Maine, Mass., N.Y., Vt.), on *Pinus banksiana* (widespread), on *Pinus resinosa* (widespread), on *Pinus strobus* (widespread, **), on *Pinus sylvestris* (N.Y.), on *Pinus virginiana* (Md., Va.)

Phanerchaete carnosa (Burt) Parmasto, on *Abies balsamea* (Mich., Minn.), on *Juniperus communis* (N.Y.), on *Juniperus virginiana* (Mass.), on *Picea mariana* (Minn.), on *Picea rubens* (Maine, Mass., N.H., Vt.), on *Pinus rigida* (N.H.), on *Pinus strobus* (Mass., Minn.)

Phanerchaete flavid-alba (Cooke) Rattan, on *Juniperus virginiana* (Ga., La.)

Phanerchaete gigantea (Fr.:Fr.) Rattan et al. in Rattan, on *Abies balsamea* (Minn.), on *Picea glauca* (Ark.), on *Pinus banksiana* (Mich.), on *Pinus resinosa* (Wisc.), on *Pinus strobus* (widespread), on *Tsuga canadensis* (Mich.)

Phanerchaete sanguinea (Fr.:Fr.) Pouzar, on *Pinus banksiana* (Mich.), on *Pinus resinosa* (Mass., Minn.), on *Pinus rigida* (N.Y.), on *Tsuga canadensis* (Wisc.)

Phanerchaete velutina (DC.:Fr.) Karst., on *Picea* sp. (N.Y.), on *Pinus resinosa* (Wisc.), on *Pinus strobus* (Mich.)

Phanerchaete viticola (Schw.) Parmasto, on *Abies balsamea* (N.H.), on *Picea* sp. (N.Y.)

Phellinus ferruginosa (Schrad.:Fr.) Karst., on *Abies balsamea* **, on *Thuja occidentalis* **, on *Tsuga canadensis* **

Phellinus gilvus (Schw.:Fr.) Pat., on *Juniperus virginiana* (widespread), on *Tsuga canadensis* (Pa.)

Phellinus pini (Thore:Fr.) Ames, on *Abies balsamea* (Minn., **), on *Juniperus virginiana* (Mass.), on *Larix laricina* (widespread, **), on *Picea glauca* (widespread), on *Picea mariana* (widespread, **), on *Picea rubens* (Conn., Maine, N.C., N.H., N.Y., W.Va.), on *Pinus banksiana* (widespread), on *Pinus resinosa* (widespread), on *Pinus rigida* (widespread, **), on *Pinus strobus* (widespread), on *Pinus sylvestris* (widespread), on *Pinus virginiana* (eastern states, Tenn.), on *Tsuga canadensis* (eastern states)

Phellinus punctatus (Fr.) Pilat, on *Abies balsamea* **, on *Picea* sp. **, on *Tsuga canadensis* (eastern states, Ga., **, Ohio)

Phellinus robustus (Karst.) Bourd. & Galzin, on *Abies balsamea* (Minn.), on *Tsuga canadensis* (widespread)

Phellinus texianus (Murr.) Ames, on *Juniperus virginiana* (Texas)

Phellinus viticola (Schw.:Fr.) Donk, on *Abies balsamea* (Minn.), on *Larix laricina* (Ark.), on *Picea abies* (northwestern states, Ark.), on *Picea mariana* (Ark.), on *Tsuga canadensis* (N.Y.)

Phlebia livida (Pers.:Fr.) Bres., on *Pinus strobus* (N.C.)

Phlebia tremellosus (Schrad.:Fr.) Nakasone & Burdsall, on *Tsuga canadensis* (N.Y.)

Phlebiella tulasnelloidea (Hoehn. & Litsch.) Oberwinkler, on *Pinus strobus* (N.Y.)

Phlebiella vaga (Fr.:Fr.) Karst., on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (Mass.)

Piloderma bicolor (Peck) Juelich, on *Picea glauca* (Ark.), on *Tsuga canadensis* (Wisc.)

Piloderma byssinum (Karst.) Juelich, on *Picea glauca* (Minn.)

Polyporus badius (Pers.) Schw., on *Tsuga canadensis* (Mich.)

Polyporus virgatus Berk. & Curtis, on *Pinus rigida* **, on *Pinus strobus* **

"*Poria pini*" (Peck) Sacc., on *Pinus rigida* **

Postia balsamea (Peck) Juelich, on *Abies balsamea* (widespread)

Postia caesia (Schrad.:Fr.) Karst., on *Abies balsamea* (Minn.), on *Juniperus virginiana* (widespread), on *Picea glauca* (Calif.), on *Picea mariana* (Ark.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Tsuga canadensis* (Maine, N.C.)

Postia fragilis (Fr.:Fr.) Juelich, on *Picea mariana* (Minn.), on *Pinus strobus* (N.C.), on *Tsuga canadensis* (N.C.)

Postia guttulata (Peck) Juelich, on *Abies balsamea* (widespread), on *Picea glauca* (widespread), on *Picea mariana* (Minn.), on *Picea rubens* (N.Y., Pa., Wash.), on *Tsuga canadensis* (N.Y.)

Postia stiptica (Pers.:Fr.) Juelich, on *Tsuga canadensis* (N.Y.)

Postia undosa (Peck) Juelich, on *Abies balsamea* (N.H.), on *Picea rubens* (Maine, N.H., N.Y.), on *Pinus rigida* (Conn.), on *Pinus strobus* (Conn., N.Y.), on *Tsuga canadensis* (N.Y.)

Pseudomerulius aureus (Fr.:Fr.) Juelich, on *Tsuga canadensis* (N.Y.)

Pseudomerulius curtisii (Berk.) Redhead & Ginns, on *Tsuga canadensis* (N.C.)

Pseudotomentella griseopergamacea Larsen, on *Pinus resinosa* (N.Y.), on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (N.Y.)

Pseudotomentella nigra (Hoehn. & Litsch.) Svrcek, on *Pinus strobus* (N.Y.)

Pseudotomentella tristis (Karst.) Larsen, on *Picea rubens* (N.Y.)

Pycnoporellus alboluteus (Ellis & Everh.) Kotlaba & Pouzar, on *Picea glauca* (Ark.), on *Picea mariana* (Mich.), on *Picea rubens* (N.Y.)

Pycnoporellus fulgens (Fr.) Donk, on *Abies balsamea* **, on *Picea glauca* (Ark.), on *Picea mariana* (Minn.), on *Picea rubens* (N.C., N.Y.), on *Tsuga canadensis* (N.Y., Tenn.)

Pycnoporus cinnabarinus (Jacq.:Fr.) Karst., on *Picea rubens* (N.Y.), on *Tsuga canadensis* (Pa., Vt.)

Pyrofomes demidoffii (Lev.) Kotlaba & Pouzar, on *Juniperus communis* (Mont.), on *Juniperus virginiana* (Kentucky, Md., Okla., Tenn.)

Ramaricium polyporoideum (Berk. & Curtis) Ginns, on *Pinus sylvestris* (N.Y.)

Resinicium bicolor (Albertini & Schw.:Fr.) Parmasto, on *Picea* sp. (N.Y.), on *Pinus resinosa* (Mass.), on *Pinus strobus* (N.Y.)

Resinicium furfuraceum (Bres.) Parmasto, on *Pinus resinosa* (Mass.), on *Pinus strobus* (Mass., Minn.), on *Tsuga canadensis* (N.H., Wisc.)

Schizophyllum commune Fr.:Fr., on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Tsuga canadensis* (N.C.)

Schizopora paradoxa (Schrad.:Fr.) Donk, on dead limbs of *Juniperus virginiana* (La.)

Scytinostroma arachnoideum (Peck) Gilb., on *Picea rubens* (N.H.)

Scytinostroma galactinum (Fr.) Donk, on *Abies balsamea* (Maine, Minn., N.Y.), on *Larix laricina* (N.Y.), on *Picea glauca* (Minn.), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Pinus resinosa* (Minn.), on *Pinus strobus* (Conn.), on *Tsuga canadensis* (Md.)

Scytinostroma ochroleucum (Bres. & Torrend) Donk, on *Tsuga canadensis* (N.H.)

Scytinostroma portentosum (Berk. & Curtis in Berk.) Donk, on dead limbs of *Juniperus virginiana* (La.)

Scytinostromella nannfeldtii (Eriksson) Freeman & Peterson, on *Picea glauca* (Ark.)

Sistotrema brinkmannii (Bres.) Eriksson, on *Pinus strobus* (Ga.), on *Tsuga canadensis* (Conn.)

Sistotrema raduloides (Karst.) Donk, on *Picea glauca* (Ark.)

Skeletocutis amorphia (Fr.:Fr.) Kotlaba & Pouzar, on *Picea* sp. (widespread), on *Pinus rigida* (Pa.), on *Tsuga canadensis* (Pa.)

Skeletocutis nivea (Jungh.) Keller, on *Chamaecyparis thyoides* **

Skeletocutis stellae (Pilat) Keller, on *Picea rubens* **

Sphaerobasidium minutum (Eriksson) Oberwinkler, on *Tsuga canadensis* (Wisc.)

Spongipellis spumeus (Sowerby:Fr.) Pat., on *Tsuga canadensis* (Maine)

Steccherinum fimbriatum (Pers.:Fr.) Eriksson, on *Pinus resinosa* (N.Y.)

Steccherinum ochraceum (Pers.:Fr.) S.F. Gray, on wood of *Juniperus virginiana* (Fla.)

Steccherinum subcrinale (Peck) Ryv., on *Pinus strobus* (Mass.), on *Tsuga canadensis* (N.Y.)

Stereum hirsutum (Willd.:Fr.) S.F. Gray, on *Juniperus virginiana* (Conn., N.C.)

Stereum sanguinolentum (Albertini & Schw.:Fr.) Fr., on *Abies balsamea* (Maine, Mich., N.H., N.Y., Vt.), on *Picea abies* (Idaho, N.Y., Vt.), on *Picea glauca* (Ark.), on *Picea rubens* (Conn., Maine, N.H., N.Y., Vt.), on *Pinus banksiana* (Conn.), on *Pinus resinosa* (Conn., Mass., N.H., N.Y.), on *Pinus rigida* (Mass.), on *Pinus strobus* (widespread), on *Tsuga canadensis* (widespread)

Subulicystidium longisporum (Pat.) Parmasto, on *Abies balsamea* (Minn.)

Suitosporium cystidiatum (D.P. Rogers) Pouzar, on wood of *Tsuga canadensis* (Conn.)

Thelephora albidobrunnea Schw., on *Juniperus virginiana* (N.C.)

Thelephora cuticularis Berk., on bark of *Juniperus virginiana* (Fla.)

Thelephora terrestris Ehrh.:Fr., "smothering of seedlings" of *Picea mariana* (Minn.), on *Pinus banksiana* (Mich.), on *Pinus strobus* (Maine, N.H., Ohio)

Tomentella asperula (Karst.) Hoehn. & Litsch., on wood of *Juniperus virginiana* (Fla., La.)

Tomentella atrorubra (Peck) Bourd. & Galzin, on *Picea* sp. (N.Y.), on *Pinus strobus* (N.Y.), on *Tsuga canadensis* (Mass., N.Y.)

Tomentella avellanea (Burt) Bourd. & Galzin, on *Pinus* sp. (N.Y.)

Tomentella botryoides (Schw.) Bourd. & Galzin, on *Pinus* sp. (N.Y.), on *Tsuga canadensis* (N.C.)

Tomentella bresadolae (Brinkmann) Bourd. & Galzin, at base of living *Juniperus virginiana* on exposed heartwood (Ohio), on *Picea* sp. (N.Y.)

Tomentella bryophila (Pers.) Larsen, on *Tsuga canadensis* (Mich., N.Y., Vt.)

Tomentella coerulea (Bres.) Hochn. & Litsch., on *Tsuga canadensis* (Mich.)

Tomentella crinalis (Fr.) Larsen, on *Tsuga canadensis* (N.Y.)

Tomentella griseo-unbrina Litsch. in Lundell, on *Tsuga canadensis* (N.Y.)

Tomentella lateritia Pat., on *Tsuga canadensis* (Mich., N.Y.)

Tomentella neobourdotii Larsen, on *Tsuga canadensis* (Mich., Tenn.)

Tomentella ochracea (Sacc.) Larsen, on *Picea* sp. (N.Y., N.J.)

Tomentella olivascens (Berk. & Curtis) Bourd. & Galzin, on *Picea* sp. (N.Y.), on *Pinus strobus* (Mass.), on *Pinus* sp. (N.Y.), on *Tsuga canadensis* (Mass., N.Y.)

Tomentella punicea (Albertini & Schw.:Fr.) Schroet. in Cohn, on *Pinus* sp. (N.Y.), on *Tsuga canadensis* (Mich.)

Tomentella ramosissima (Berk. & Curtis) Wakef., on *Pinus* sp. (widespread)

Tomentella rubiginosa (Bres.) Maire, on *Picea rubens* (N.H.), on *Pinus* sp. (N.Y.)

Tomentella ruttneri Litsch., on *Picea* sp. (Mich., N.Y.), on *Pinus* sp. (Ark., N.Y.), on *Tsuga canadensis* (N.Y.)

Tomentella subtilacina (Ellis & Holway) Wakef., on *Picea* sp. (Mich., N.Y.), on *Pinus* sp. (Mass., Md., N.Mex., N.Y., Tenn.), on *Tsuga canadensis* (Mass., N.Y.)

Tomentella terrestris (Berk. & Broome) Larsen, on *Pinus* sp. (Ariz., Mont., N.Mex., N.Y.), on *Tsuga canadensis* (N.Y.)
Trametes hirsuta (Wulfen:Fr.) Quel., on *Juniperus virginiana* (N.C.), on *Tsuga canadensis* (N.Y.)
Trametes versicolor (L.:Fr.) Pilat, on *Abies balsamea* (N.Y.), on *Juniperus virginiana* (widespread, **), on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Pinus* sp. (widespread), on *Tsuga canadensis* (widespread)
Trametes villosa (Fr.:Fr.) Kreisel, on *Chamaecyparis thyoides* (N.C., Va.), on *Juniperus virginiana* (Mo., Tex.)
Trechispora cohaerens (Schw.) Juelich & Stalpers, on *Abies balsamea* (Minn.)
Trechispora farinacea (Pers.:Fr.) Liberta, on *Juniperus virginiana* (Fla.), on *Pinus resinosa* (N.Y.), on *Pinus sylvestris* (N.Y.), on *Tsuga canadensis* (Wisc.)
Trechispora lunata (Bourd. & Galzin) Juelich, on *Pinus resinosa* (Mass.)
Trechispora mollusca (Pers.:Fr.) Liberta, on *Abies balsamea* **, on *Picea* sp. **, on *Thuja occidentalis* **
Trichaptum abietinum (Dickson:Fr.) Ryv., on *Chamaecyparis thyoides* (Maine, **), on *Juniperus virginiana* (N.C.), on *Larix laricina* (Ark., **), on *Picea glauca* (Ark., Maine), on *Picea mariana* **, on *Picea rubens* (Conn., Maine, N.H., N.Y., Pa.), on *Pinus resinosa* (Mich.), on *Pinus rigida* **, on *Tsuga canadensis* (widespread)
Trichaptum biforme (Fr.) Ryv., on *Picea glauca* (Ark.), on *Tsuga canadensis* (Ga., N.Y., Pa.)
Trichaptum fusco-violaceum (Fr.) Ryv., on *Abies balsamea* **, on *Picea* sp. **
Trichaptum larinum (Karst.) Ryv., on *Picea rubens* (N.Y.)
Trichaptum sector (Ehrenb.:Fr.) Kreisel, on *Chamaecyparis thyoides* (N.C.)
Tubulicium clematis (Bourd. & Galzin) Oberwinkler, on wood of *Juniperus virginiana* (Fla.)
Tubulicrinis accedens (Bourd. & Galzin) Donk, on *Pinus strobus* (Mass.), on *Tsuga canadensis* (R.I.)
Tubulicrinis angustus (D.P. Rogers & Weresub) Donk, on *Pinus strobus* (R.I.), on *Tsuga canadensis* (Wisc.)
Tubulicrinis calothrix (Pat.) Donk, on *Pinus strobus* (Mass.), on *Tsuga canadensis* (Wisc.)
Tubulicrinis glebulosus (Bres.) Donk, on wood of *Tsuga canadensis* (Wisc.)
Tubulicrinis medius (Bourd. & Galzin) Oberwinkler, on dead limbs of *Juniperus virginiana* (La.)
Tubulicrinis propinquus (Bourd. & Galzin) Donk, on *Picea glauca* (Mass.)
Tubulicrinis sceptiferus (H. Jacks. & Weresub) Donk, on wood of *Tsuga canadensis* (Wisc.)
Tubulicrinis subulatus (Bourd. & Galzin) Donk, on *Pinus resinosa* (Mass.), on *Pinus strobus* (Mass.)
Vararia boreale Pouzar, on *Pinus resinosa* (Minn.)
Vararia gomezii Boidin & Lanquetin, on dead limbs of *Juniperus virginiana* (La.)
Vararia investiens (Schw.) Karst., on *Abies balsamea* (Maine), on *Picea rubens* (N.H.), on *Pinus strobus* (N.Y.)
Wolfiporia cocos (F.A. Wolf) Ryv. & Gilb., on *Abies balsamea* (Minn., Pa.), on *Juniperus virginiana* (N.C.), on *Tsuga canadensis* (Wisc.)
Wrightoporia lenta (Overh. & Lowe) Pouzar, on *Tsuga canadensis* (N.Y.)
Wrightoporia subrutilans (Murr.) Ryv., on *Abies balsamea* (Maine), on *Tsuga canadensis* (Vt.)
Xenasma pulverulentum (Litsch.) Donk, on *Tsuga canadensis* (Wisc.)
Xenosperma murrillii Gilb. & Blackwell, on limbs of *Juniperus virginiana* (Fla.)
Xylobolus frustulans (Pers.:Fr.) Karst., on stumps of *Pinus strobus* (N.C., S.C.)

AGARICALES

Anthracophyllum lateritium (Berk. & Curtis) Singer, on dead limbs of *Juniperus virginiana* (La.)
Armillaria mellea (Vahl:Fr.) Kumm., on *Abies balsamea* (New England states, Minn.), on *Chamaecyparis thyoides* (Va.), on *Picea glauca* (Vt.), on *Picea rubens* (Conn., Maine, Mass.), on *Pinus banksiana* (Mich., Minn.), on *Pinus rigida* (Pa.), on *Pinus strobus* (widespread), on *Tsuga canadensis* (northeastern states, Ga., Mich., N.C.)
Baeospora myosura (Fr.:Fr.) Singer, on cones of *Pinus strobus* (Minn.)
Clitocybe martiorum J. Favre, on dead needles of *Pinus strobus* (Mich.), of *Pinus sylvestris* (Mich.)
Clitocybula abundans (Peck) Singer, on wood of *Tsuga canadensis* (Vt.)
Collybia acervata (Fr.:Fr.) Kumm., on debris, logs, and stumps of *Picea rubens* (N.C., Tenn., Va., W.Va.)
Crepidotus fusicporus Hesler & A.H. Smith var. *abietinus* Hesler & A.H. Smith, on dead twigs of *Abies balsamea* (Mich.)
Cyphellopsis anomala (Pers.:Fr.) Donk, on *Abies balsamea* (N.H.)
Cryptotrama asprata (Berk.) Redhead & Ginns, on *Picea rubens* (N.C., Tenn.)
Galerina autumnalis (Peck) A.H. Smith & Singer, on dead limbs of *Pinus virginiana* (Va.)
Galerina tsugae A.H. Smith & Singer, on logs of *Tsuga canadensis* (Mich.)
Gymnopilus naucorioides Hesler, on stumps of *Tsuga canadensis* (Tenn.)
Gymnopilus pulchrifolius (Peck) Murr., on wood of *Tsuga canadensis* (N.Y.)
Hemimycena albida (Murr.) Singer, on *Juniperus virginiana* (Fla.)

Hohenbuehelia approximans (Peck) Singer, on *Juniperus virginiana* (Fla.)
Hohenbuehelia elegans (Coker) Singer, on bark of living trees? (N.C.)
Hydropus marginellus (Pers.:Fr.) Singer, on *Picea rubens* (N.C., Tenn., Va., W.Va.)
Hypholoma capnoides (Fr.:Fr.) Kumm., on wood of *Tsuga canadensis* (N.C.)
Hypholoma fasciculare (Huds.:Fr.) Kumm., on *Juniperus virginiana* (Fla.), on *Pinus strobus* (N.C.)
Hypsizygus tesselatus (Bull.:Fr.) Singer, on wood of *Tsuga canadensis* (N.C.)
Marasmiellus filipes (Peek) Redhead, on *Abies balsamea* (N.Y.)
Marasmiellus juniperinus Murr., on living limbs of *Juniperus virginiana* (La.)
Mycena austini (Peek) Kuehner, on wood of *Picea* sp. (N.Y.)
Mycena borealis A.H. Smith, on wood of *Picea rubens* (Va., W.Va.)
Mycena clavicularis (Fr.:Fr.) Gill., on dead needles of *Pinus virginiana* (Va.)
Mycena longisetata Hoehn., on dead needles of *Picea rubens* (Va.)
Mycena plumbea (Fr.) Sae., on dead needles of *Picea* sp. (Colo., Mich., N.Y.)
Mycena subincarnata (Peek) Sae., on dead needles of *Pinus strobus* (N.Y.)
Mycena subplicosa Karst., on dead needles of *Picea* sp. (Calif., Mich., N.Y., Oreg., Wash.)
Mycena tenax A.H. Smith, on dead needles of *Abies balsamea* (N.Y.), on dead needles of *Picea rubens* (N.Y.)
Neolentinus adhaerens (Albertini & Schw.:Fr.) Redhead & Ginns, on *Tsuga canadensis* (Maine, N.H.)
Neolentinus lepideus (Fr.:Fr.) Redhead & Ginns, on *Picea rubens* (Conn., Maine, N.H., N.Y.), on *Pinus banksiana* (Minn.), on
Pinus strobus (widespread)
Omphalina epichysium (Pers.:Fr.) Quel., on stumps of *Tsuga canadensis* (Tenn.)
Panellus pusillus (Peek) Burdsall & O.K. Miller, on *Pinus strobus* (S.C.)
Panellus stipticus (Bull.:Fr.) Karst., on *Picea rubens* (Conn., Maine, N.H., N.Y.)
Paxillus atrotomentosus (Batsch:Fr.) Fr., on decaying logs of *Tsuga canadensis* (Ga., N.C., S.C.)
Pholiota alnicola (Fr.:Fr.) Singer, on *Tsuga canadensis* (N.C.)
Pholiota flammans (Fr.:Fr.) Kumm., on *Tsuga canadensis* (N.C.)
Pholiota squarrosoides (Peek) Sace., on *Tsuga canadensis* (N.C.)
Pluteus fuliginosus Murr., on stumps of *Pinus strobus* (N.Y.)
Psathyrella atomatoides (Peek) A.H. Smith, on *Tsuga canadensis* (N.C.)
Resupinatus applicatus (Batsch:Fr.) S.F. Gray, on *Juniperus virginiana* (N.C.)
Stigmatella taxi (Lev.) Donk, on bark of *Juniperus virginiana* (Fla., Ga., La., S.C.)
Strobilurus occidentalis V. Wells & P. Kempton, on cones of *Picea glauca* (Ark.)
Tricholomopsis decora (Fr.:Fr.) Singer, on *Tsuga canadensis* (N.C.)
Tricholomopsis rutilans (Sehaeff.:Fr.) Singer, on *Picea* sp. (N.H.)
Tricholomopsis sulfureoides (Peek) Singer, on wood of *Tsuga canadensis* (N.Y.)
Xeromphalina campanella (Batsch:Fr.) Kuehner & Maire, on rotten logs and stumps of *Picea rubens* (N.C., Tenn., Va., W.Va.)

NIDULARIALES

Crucibulum laeve (Bull.) Kambly in Kambly & Lee, on *Juniperus virginiana* (N.C.)

LYCOPERDALES

Lycoperdon pyriforme Sehaeff.:Pers., on *Tsuga canadensis* (N.C.)

MONILIALES

Aureobasidium pullans (de Bary) Arnaud, on *Pinus resinosa* (northeastern states, Wise.)
Berkleasmium concinnum (Berk.) Moore, on *Tsuga canadensis* (N.C.)
Botrytis cinerea Pers.:Fr., seedling blight, on *Picea abies* (N.J.), on *Picea rubens* (N.C.)
Cephalosporium sp., canker on *Abies balsamea* (Minn., Wise.)
Cercospora sequoiae Ellis & Everh., on *Juniperus virginiana* (Ga., S.C.)
Cercospora sequoiae Ellis & Everh. var *juniperi* Ellis & Everh., on *Juniperus communis* (Conn., Wise.), on *Juniperus virginiana* (Ark., Fla., Ga., Mo., N.C., Neb., Okla., S.C., Va., Wisc.)
Chalara theielavioides (Peyronel) Nag Rag & Kendriek, black mold on *Juniperus virginiana* (N.J.)
Confistulina hepatica (Sace.) Stalpers in Stalpers & Vlug, on *Pinus virginiana* (Md.)

Conoplea abietina (Peck) Hughes, on *Picea* sp. (N.Y.)
Conoplea fusca Pers., on *Juniperus virginiana* (N.C.)
Conoplea geniculata (Corda) Hughes, on *Abies balsamea* (N.Y.)
Conoplea juniperi Hughes, on dead needles and limbs of *Juniperus virginiana* (Conn., Del., Ind., Maryland, Mass., Mich., N.C., N.J., N.Y., Ohio, Pa.)
Corynespora olivacea (Wallr.) Ellis, on *Tsuga canadensis* (W.Va.)
Curvularia intermedia Boedijn, seedling tip blight on *Juniperus virginiana* (Ariz.)
Cylindrocladium scoparium Morg., damping off, on *Picea abies* (N.J.), on *Picea glauca* (Minn.), on *Picea mariana* (Minn.), on *Pinus resinosa* (Minn.), on *Pinus rigida* (N.J., Pa.), on *Pinus strobus* (N.C., N.J., W.Va.), on *Tsuga canadensis* (N.J.)
Eustilbum aureum (Pers.:Fr.) Seifert & Carp., on resin of *Abies balsamea* (N.Y.)
Fusarium avenaceum (Fr.:Fr.) Sacc., seedling blight, on *Pinus resinosa* (Pa.)
Fusarium lateritium Nees:Fr., on *Pinus strobus* (Va.)
Fusarium lateritium Nees:Fr. f.sp. *pini* Hepting, on *Pinus rigida* (N.C.), on *Pinus virginiana* (Fla., Ga., N.C., S.C., Va.)
Fusarium oxysporum Schlect.:Fr., on *Pinus resinosa* (N.Y., Pa.)
Fusarium subglutinans (Wollenweb & Reinking) P.E. Nelson, Toussoun & Marasas, on *Pinus sylvestris* (N.C.)
Haplodichthium ramosissimum (Berk. & Curtis) Holubova-Jechova, on roots of *Tsuga canadensis* (Vt.)
Hyalotrichophora lignitalis (Thaxt.) Finley & Morris, on *Pinus strobus* (Mass.)
Illosporitum conicola Ellis & Everh. in Shear, on cones of *Pinus virginiana* (D.C.)
Leptographium procerum (Kendrick) Wingfield, on *Pinus strobus* (Minn., N.Y., Pa., Va.), on *Pinus sylvestris* (Mass., Va.)
Leptographium terebrantis Barras & Perry, blue stain associated with the beetle, *Dendroctonus terebrans*, on *Pinus sylvestris* (Mass.)
Pullularia sp., isolated from basal cankers on *Pinus strobus* (N.Y.)
Sporidesmium hysterioideum Cooke & Ellis, on *Juniperus virginiana* (Del.)
Stigmina defectens (Karst.) Ellis, on *Juniperus virginiana* (S.D.)
Stigmina glomerulosa (Sacc.) Hughes, needle blight, twig blight on *Juniperus communis* (Iowa, Utah), on *Juniperus virginiana* (N.C., S.C., Va.)
Stigmina juniperina (Georgescu & Badea) Ellis, needle cast on *Juniperus communis* (Mich., Wisc.)
Tuberculina maxima Rostr., on *Pinus strobus* (Mich.)

SPHAEROPSIDALES

Aplosporella juniperi (Peck) Petr., on *Juniperus virginiana* (Kan., Mich., N.Y.)
Aplosporella pini Peck, on *Pinus strobus* (N.Y.)
Ascochyta conicola Dearn. & House, nom. nud., on cone scales of *Tsuga canadensis* (N.Y.)
Bothrodiscus bernice (Berk. & Curtis) Groves, on branches of *Abies balsamea* (Mich., Minn.)
Botryodiplodia juniperina (Peck) Petr. & Syd., on dead limbs of *Juniperus virginiana* (N.Y.)
Camarosporium pini (Westend.) Sacc., on twigs of *Pinus strobus* (Pa.)
Cytospora chrysosperma (Pers.:Fr.) Fr., canker on *Picea abies* (New England states, Ill.)
Cytospora kunzei Sacc., canker on *Abies balsamea* (Maine, Vt.), on *Picea abies* (Conn., Mass.), on *Picea glauca* (Conn., Mass., N.J.), on *Picea rubens* (Maine, N.H., N.Y.), on *Pinus strobus* (Conn., Maine, N.C.), on *Tsuga canadensis* (Conn., N.C., N.H.)
Cytospora leucostoma Sacc., canker on *Picea abies* (New England states, Ill.)
Cytospora pinastri Fr.:Fr., twig and branch canker and on needles of *Abies balsamea* (Maine, Minn., Wisc.), on *Pinus sylvestris* (Maine, N.J., Pa.)
Diplodia megalospora Berk. & Curtis, blue-gray stain on *Pinus strobus* (N.Y.), on *Pinus virginiana* (Va.)
Diplodia thyoidea Cooke & Ellis, on bark of *Chamaecyparis thyoides* (N.J.)
Diplodia virginiana Cooke & Rav., on twigs of *Juniperus virginiana* (S.C.)
Dothistroma septospora (Doroguine) Morelet, on *Pinus resinosa* (Ohio, Okla.), on *Pinus sylvestris* (Va.)
Foveostroma abietinum (Peck) DiCosmo, on *Abies balsamea* (Maine), on *Tsuga canadensis* (N.C.)
Harknessia thujina Ellis & Everh., on foliage of *Chamaecyparis thyoides* (N.Y.), on *Juniperus virginiana* (Texas)
Hendersonia thyoides Cooke & Ellis, on foliage of *Chamaecyparis thyoides* (N.J.)
Hendersonula pinicola Dearn., on *Pinus strobus* (N.C., Tenn.)
Leptostroma rostrupii Minter, on *Pinus sylvestris* (Wash.)
Leptothyrium stenosporum Dearn., on *Pinus strobus* (Ga.)
Macrohomina phaseolina (Tassi) Goidanich, charcoal rot of *Juniperus virginiana* (Okla.), damping off of *Picea abies* (N.C.)

Phacidiopycnis pseudotsugae M. Wilson) G. Hahn, on *Abies balsamea* (New England states), on *Larix laricina* (New England states), on *Pinus strobus* (northeastern states), on *Tsuga canadensis* (Pa.)
Phoma acutum Cooke & Ellis, on twigs and cones of *Pinus* sp. (N.J., N.Y.)
Phoma bacteriophila Peck, on *Pinus strobus* (N.Y.)
Phoma harknessii Sacc., on twigs and cones of *Pinus strobus* (northeastern states)
Phomopsis conorum (Sacc.) Died., on *Pinus strobus* (Iowa), on *Pinus sylvestris* (Iowa)
Phomopsis juniperovora Hahn, on *Juniperus communis* (eastern states, Kan., Neb.), *Juniperus virginiana* (widespread)
Phomopsis occulta (Sacc.) Traverso, needle necrosis, on *Juniperus virginiana* (Maryland, Mass.), on *Picea* sp. (New England states, on *Tsuga canadensis* (Mass., N.J., N.Y.)
Phomopsis strobi Syd. in Syd. & Petr., on limbs, associated with rust galls, on *Pinus strobus* (Maine)
Pseudocenangium succineum (Spree) Dyko & Sutton, on needles of *Pinus rigida* (N.J.)
Rhabdospora mirabilissima (Peck) Dearn. & House, stem canker of seedlings of *Pinus strobus* (N.Y.)
Rhabdospora pinea (Berk. & Curtis) Sacc., on limbs of *Pinus sylvestris* (Wisc.)
Rhizosphaera kalkhoffii Bubak, Swiss needle cast, on *Picea abies* (Pa.), on *Picea glauca* (Pa.), on *Picea mariana* (Pa.)
Sclerophoma pityella (Sacc.) Died., on *Pinus strobus* (N.Y., Pa.)
Sclerophoma pythiophila (Corda) Hoehn., tip dieback of *Juniperus virginiana* (Wisc.), on cones scales of *Picea abies* (Maine, Ohio), on *Pinus banksiana* (Wisc.), on *Pinus resinosa* (Wisc.), on *Pinus strobus* (Wisc.), on *Pinus sylvestris* (Wisc.)
Septoria spadicea F. Patterson & V. Charles, needle blight of *Pinus strobus* (N.H., N.Y., Vt.)
Sirococcus conigenus (DC.) P. Cannon & Minter, on *Picea abies* (N.C.), on *Picea glauca* (N.C.), on *Picea rubens* (N.C.), on *Pinus resinosa* (Mich., Minn., Wisc.)
Sirothyriella pini-austriacae (Roum. & Fautrey) Sutton, on needles of *Pinus resinosa* (Wisc.)
Sphaeronaema pithyrum Sacc., on limbs and trunks of *Pinus strobus* (N.Y.)
Sphaeropsis abietis Povah, on needles of *Abies balsamea* (Mich.)
Sphaeropsis sapinea (Fr.:Fr.) Dyko & Sutton in Sutton, on *Juniperus communis* (N.J.), on *Picea abies* (N.J.)
Stagonospora pini Grove, on foliage and twigs of *Juniperus virginiana* (Ill., Texas)
Stegonsporiopsis cenangoides (Ellis & Rothr.) Van Warmelo & Sutton, on dead limbs of *Abies balsamea* (Pa.)

MELANCONIALES

Coryneum stromatoideum (Dearn.) Sutton, on dead limbs of *Tsuga canadensis* (N.Y.)
Cryptosporium macrosporum Peck, canker on *Abies balsamea* (New England states, N.Y.)
Pestalotia stevensonii Peck, on cone scales of *Picea abies* (Pa.)
Pestalotia thuicola J.L. Maas, on shoots of *Picea abies* (Mass.)
Pestalotiopsis funerea (Desmaz.) Steyaert, on *Chamaecyparis thyoides* (Mich., N.J.), on *Juniperus communis* (Calif., Ga., Ill., Mich., N.J., S.C., Texas), on *Juniperus virginiana* (Mich., Miss., N.J., Tenn., Texas, Wisc.), on *Pinus resinosa* (Md., Tex.), on *Pinus strobus* (widespread), on *Pinus sylvestris* (widespread)
Phragmotrichum chailletii Kunze in Kunze & Schumach., on cones of *Picea rubens* (N.C., N.Y.)
Rhabdogloeopsis balsameae (J.J. Davis) Petr., needle blight on *Abies balsamea* (Wisc.)
Scimatosprium foliicola (Berk.) Shoemaker, on needles of *Pinus strobus* (D.C., Mass.)
Seiridium unicornis (Cooke & Ellis) Sutton, on foliage of *Chamaecyparis thyoides* (Ga., N.J.), on *Juniperus virginiana* (S.C.)
Truncatella angustata (Pers.) Hughes, on cones and twigs of *Picea abies* (N.Y.)
Tuberculariella ips Leach, Orr, & Christensen, blue stain on *Pinus resinosa* (Minn.)

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